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BRIDGING ENVIRONMENTAL CONFLICTS WITH SOCIAL METABOLISM

FORESTRY EXPANSION AND SOCIOECONOMIC CHANGE

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To the memory of my grandfather Barbas,
who introduced me to frugality and values beyond consumerism

To the future of Violetta,
that her voice will never be silenced by the plunderers in power

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Preface

> "Theory must be tested out in practice; and practice is the best source of theory. In the best possible situation the two create each other in a cyclic process in which neither is dominat but each is the source of the other." – Checkland and Scholes (1990, p. xiv, *cit* Giampietro (2004))

This research started with field work, after an inspiring year of doctoral classes at the Autonomous University of Barcelona. I went from South to North of Portugal to contact people who had been involved in the conflicts and to look at newspaper pieces that describe and immortalize such episodes. In the way I have met many people who can describe the conflicts as if they had been yesterday. Some were in favour, others were against and used the talk to denounce, probably for the nth time, the advantage that was being taken by some political groups. I explored in more detail - which meant contacting local people and actors, as well as looking at the socioeconomic and ecological characteristics of the place - three conflicts (Mértola, Aboboreira and Valpaços) and one case of eucalyptus afforestation with no apparent conflicts (Mortágua).

The most interesting of these cases I found in the Aboboreira mountain, where a community of mostly illiterate mountain peasants stood against the projected eucaliptization by a national paper pulp corporation. In my first visit, after explaining what I was doing there, I was invited to their homes to eat and drink wine. I almost had to ask nothing. They were happy to revive the events that happened in 1989. To talk how the "doctors", "those with studies" (the environmentalists) were coming to meet and sometimes even sleep in their houses, to prepare a joint strategy of struggle. Such struggles even allowed these nearly non-travelling people to travel nearly 100 km to join the struggles of others.

I placed a major focus on this particular conflict and community. I visited them often, while staying at my elder family village nearby. But suddenly I found myself stuck with

the lack of tools and theoretical background to undertake my analysis of the conflicts. To overcome my theoretical shortcomings, I dived into areas I considered important to provide me tools to understand the dynamics and causes of environmental conflicts. These ranged from complex systems theory, to economics (particularly ecological economics) and multiple approaches to environmental conflicts and security, coming from such diverse disciplines as geography, sociology, anthropology, economy, political sciences or political ecology.

With this in hand, I moved back into the empirical research - in the field and gathering historical data from newspapers and interviews. The field work was inspired by methods from cultural anthropology. These included direct observation of the local communities dynamics, informal individual and collective interviews and discussions, as well as partial life histories of the main case study (Aboboreira). Participation in the community life was done to a limited extent in the main case study (no overnight stays). It took a few months to gather the values and narratives that were involved in the conflicts.

The contexts of the conflicts against eucalyptus plantations, including the three that were reviewed in more detail, were pretty diverse. They included mountain peasants with relatively low contact with the market, modernised farmers, economically decaying farms, as well as non-inhabited sites with high natural values. But, on the other hand, all of them shared at least something in common: a very specific period in time, an opposition against the very same object and, to a certain extent, a similar critique, despite the different values and languages expressed. Therefore, understanding the big picture would have to deal with something that was not visible by looking at the local.

Complex systems theory came to help here. A systemic approach would allow looking at the big picture and identify the relevant dynamics that can be in play in a conflict situation. To do so, I followed the proposal of Robert Rosen and went back to “the world of the system theorist, developing a language appropriate to ”material organization“ and thereby clothing that world in a substance and coherence it has largely lacked” (Rosen, 1991, p.15). Starting with this “world of the mathematician”, a “world of formalisms and formalizations”. The developed framework for analysing conflicts - which necessarily involved multiple iterations which are not explicitly described along the work - was then applied and tested using the empirical data.

Abstract

Environmental conflicts have traditionally been approached from several scientific fields. However, the different theoretical and empirical developments have proceeded in parallel, with often competing descriptive languages. Furthermore, they tend to focus on resolution, while neglecting the role of conflicts as an expression of groups facing social and ecological injustices perpetrated by the hegemony. This research attempted to build a politically useful understanding of why and how environmental conflicts appear, through interdisciplinary bridging and the avoidance of the post-political hegemony. By focusing on an *ex-post* historical analysis of the conflicts against eucalyptus plantations in Portugal in the late 1980s, it attempted to identify patterns and dynamics that relate to conflicts. Theories were anchored along the concepts of social metabolism and, more particularly, the framework of multiple scale integrated assessment of societal and ecological metabolism (MuSIASEM). An adaptation of MuSIASEM for conflict analysis was iteratively developed with the empirical analysis of the political ecology of the case study. During the pre-analytical phase, an open information space is developed, comprising environmental conflicts literature, as well as the environmental history and institutional analysis of the case study. The information space is subjected to successive compressions before reaching a relevant structure of the problem. A storyteller is defined according to the relative power imbalances of the conflict situation. Theoretical pathways are created to serve as auxiliaries for the formalization process and for structuring the analysis. The analysis process navigates through the formalizations within each theoretical pathway. Impredicative loop analysis (ILA) is used to expose tensions and constraints generated by emerging hypercycles or clashing metabolic profiles. Finally, the results are subjected to a dialectical discussion, allowing the communication between different pathways. Dialectical discussion along the pathways is particularly useful for promoting interdisciplinary dialogue. The political ecology analysis of the case study has revealed that the higher intensity of conflicts in the late 1980s was due to a series of factors. The immediate cause was resource

scarcity, which led to a speculative race for lands that included land grabbing strategies. The growing environmental movement in Portugal has provided the rural and peasant identities (the storytellers), with new languages that empowered their struggles. Institutional changes contributed to conflicts attenuation in the 1990s. However, a growing global consumption of paper continues to push the frontiers of industrial forestry around the world. Latin America and Eastern Europe have increased their peripheral position in the world-system of the paper industry, as suppliers of cheap pulp and land for fast-growth tree plantations. Packaging, as a main end-use of paper, can be used to hide from the consumer the impacts of production. This end-use of paper might intensify unequal ecological exchange in different areas and commodities, while being reinforced by it. In this context, conflicts might lead to a relocation of impacts, leaving the hegemony untouched.

Keywords: social metabolism, political ecology, ecological economics, environmental conflicts, environmental security, history, unequal exchange, environmental load displacement, consumption, commodity fetishism, mirror phase, resource scarcity, resource capture, resource frontier, hegemony, post-politics, narratives, storyteller, theoretical pathways, core-periphery, world-systems, eucalyptus, pulp, paper, industry, modernization, agriculture, Portugal

Sumário

Os conflitos ambientais têm sido tradicionalmente abordados por várias áreas científicas, desde a ciência política até à economia ou ciências ambientais. Contudo, os vários desenvolvimentos teóricos e empíricos ocorreram em paralelo, muitas vezes com linguagens descriptivas que competem entre si. Além disso, tendem a focar-se na resolução, negligenciando o papel dos conflitos enquanto expressão de grupos que enfrentam injustiças ecológicas e sociais perpretadas pela hegemonia. Esta investigação procurou desenvolver uma compreensão politicamente relevante sobre porquê e como surgem os conflitos ambientais, através de pontes interdisciplinares e da fuga à hegemonia pós-política. Ao focar-se numa análise histórica *ex-post* dos conflitos contra as plantações de eucaliptos em Portugal no final da década de 1980, procurou identificar padrões e dinâmicas associadas aos conflitos. Diferentes abordagens teóricas foram ancoradas em torno do conceito de metabolismo social e, mais particularmente, da estrutura da Avaliação Integrada em Múltiplas Escalas do Metabolismo Ecológico e da Sociedade (MuSIASEM). Uma adaptação do MuSIASEM para a análise de conflitos foi desenvolvida de forma iterativa com a análise empírica da ecologia política do caso de estudo. Durante a fase pré-analítica, é desenvolvido um espaço de informação aberto, que inclui literatura sobre conflitos ambientais, bem como a história ambiental e a análise institucional do caso de estudo. O espaço de informação é submetido a sucessivas compressões antes de alcançar uma estrutura relevante para o problema. Um contador da história deve ser definido tendo em conta os desequilíbrios de poer relativos da situação de conflito. Caminhos teóricos são criados para auxiliarem o processo de formalização e para estruturarem a análise. O processo de análise navega através das formalizações dentro de cada caminho teórico. Análises de ciclos impredicativos (ILA) são usadas para expôr as tensões e restrições geradas pelos hiperciclos em emergência ou perfis metabólicos em confronto. Por fim, os resultados são submetidos a uma discussão dialética, permitindo a comunicação entre os diferentes caminhos. A discussão dialética em torno dos caminhos é particularmente útil na promoção do diálogo

interdisciplinar. A análise da ecologia política do caso de estudo revelou que a maior intensidade de conflitos no final dos anos 80 se deveu a uma série de fatores. O mais imediato foi a escassez de recursos, que conduziu a uma corrida especulativa por terras, que incluiram estratégias de apropriação de terras. O crescimento do movimento ambientalista em Portugal, forneceu às identidades rurais e camponeses (os contadores da história) novas linguages que empoderaram as suas lutas. Alterações institucionais contribuíram para o atenuar dos conflitos nos anos 90. No entanto, um consumo global crescente de papel continua a empurrar as fronteiras da floresta industrial pelo mundo fora. A América Latina e a Europa Ocidental intensificaram a sua posição de periferia no sistema-mundo da indústria do papel, como fornecederos de pasta barata e terra para as plantações de crescimento rápido. As embalagens, como principal uso final do papel, podem ser usadas para esconder do consumidor os impactos da produção. Este uso final do papel pode intensificar o intercâmbio ecologicamente desigual em diferentes áreas e comodidades, ao mesmo tempo que é reforçado por ele. Neste contexto, os conflitos podem conduzir a uma relocalização dos impactos, sem afectar a hegemonia.

Palavras-chave: metabolismo social, ecologia política, economia ecológica, conflitos ambientais, segurança ambiental, história, intercâmbio desigual, deslocalização da carga ambiental, consumo, fetichismo das comodidades, fase do espelho, escassez de recursos, captura de recursos, fronteira de recursos, hegemonia, pós-política, narrativas, contador da história, caminhos teóricos, centro-periferia, sistema-mundo, eucalipto, pasta, papel, indústria, modernização, agricultura, Portugal

Glossary

Ag - agriculture

AV - added value

Bio - biomass

CAL - colonized appropriated land (LIP+LUA)

Cons - consumption

DE - domestic extraction

DHA - disposable human activity (THA excluding physiological overhead)

DMC - domestic material consumption

DMI - domestic material input

ET - exosomatic throughput

EV - export value

Exp - exports

For - forestry

GDP - gross domestic product

HA - human activity

HC+LE - household chores and leisure

HH - household

ILA - impredicative loop analysis

INE - Instituto Nacional de Estatística (Portuguese National Statistics Institute)

Imp - imports

LIA - land in agriculture

LIF - land in forestry

LIP - land in production (LIF+LIA)

MuSIASEM - multiple scale integrated analysis of societal and ecosystem metabolism

LUA - land in urban and other artificial types of occupation (roads, buildings, extractive industries, etc.)

NCL - non-colonized land (for human related activities). It gives a measure of the pressure of the socioeconomy over the territory (TAL-CAL)

PO - physiological overhead (personal care)

PP - pulp and paper sector

Pri - primary sector (excluding extractive activities, comprising only agriculture, forestry and fisheries)

Prod - production

PS - productive sector

PW - paid work

SG - services and goods

TAL - total available land (land area, excluding water)

TET - total exosomatic throughput

THA - total human activity (24 hours x 365 days per year)

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Part I

Background

Chapter 1

Introduction

In the region of Trás-os-Montes, in the far North-East of Portugal, two thousand locals and ecologists took part in a direct action against an eucalyptus plantation in the winter of 1989. The population faced repression by the police, who attempted to stop the act of civil disobedience. However, this did not stop the demonstrators to remove three thousand newly planted eucalyptus, in order to defend their water sources, agriculture and land. This rural battle resulted in a victory for the protesters, as the cellulose company, fearing further demonstrations - which were, by then, taking place all around the country - has decided to abandon the afforestation and resold the lands.

Conflicts around eucalyptus plantations in Portugal have had their major expression during the second half of the 1980's. By then, lands were being taken for afforestation with eucalyptus at a pace without precedents. The national paper pulp industry required raw materials to supply the increasing production. Opposing this expansion were very diverse groups, ranging from environmentalists with concerns over the biodiversity, to near-subsistence peasants which wanted to preserve their lands for farming and pasture grazing.

Opposition to tree plantations in Portugal was not exclusive of this period. During

the fascist regime[1], particularly in the 1930s and 1940s, pine tree plantations where pushed by the State to common and marginal lands. The imagery of the opposition to the regime's plan to "promote development" in the rural areas has been very well portrayed in Aquilino Ribeiro's novel "Quando os Lobos Uivam" (When the Wolves Howl).

In other regions of the world, particularly in the global (political) South, conflicts have also burst as a result of the expansion of rapid-growth monoculture plantations[2], which supply the production of paper pulp (Schütz, 2008) or, more recently, agrofuels (see Dauvergne & Neville, 2010). Carrere & Lohmann (1996) have extensively described the local and regional social and environmental impacts of fast-growing tree plantations used for pulp production, as well as related conflicts.

An important conflicting situation derives from the replacement of either traditional uses of land or ative vegetation (with slower growth and higher biodiversity) with fast-growing tree plantations (Guha, 1999; Martinez-Alier, 2004b). This issue becomes a particularly sensitive one when it relates to the loss of access to land and forests, which communities have long used under customary law (Nelson & de Jong, 2003). Gerber *et al.* (2009) have suggested that opposition to fast-growth monoculture plantations is, in part, derived from an appropriation of the materials, and energy, particularly in the form of net primary production (measured with the indicator HANPP[3]), which is exported.

Opposition to tree plantations is just one of many examples of environmental conflicts. The peasants of the rural Portugal opposing the eucalyptus plantations, the victims of the industrial accident of Bhopal, the Ogoni in the Niger delta or the indigenous people in Chiapas, share their struggles and languages against the dispossession of their lands and resources, which are extracted to feed the global markets. More recently, multinationals have turned to the appropriation of intelectual property. Groups

[1] many contemporary historians prefer to call this the period of the "New State"(*Estado Novo*. I particularly dislike this designation because it hides the oppression and atrocities committed by this regime

[2] the unfamiliar reader can get an overview of these conflicts by browsing the World Rainforest Movement website, at http://www.wrm.org.uy

[3] human appropriation of net primary production

opposing to this “bioprospection”, have renamed it “biopiracy”, as they consider these acts to result in an appropriation of the common knowledge developed by indigenous people and peasants over thousands of years. All these groups have been, in a way or another, victims of violence and repression by the State or organised groups. The development models of the hegemony, are often enforced through the silencing of multiple forms of expression of opposing groups.

Studying environmental conflicts is synonym to understanding severe maladjustments between human society and the environment, as well as tensions between social groups in relation to environmental services or assets. As such, by focusing on environmental conflicts, it becomes possible to better comprehend the meaning of sustainability, what languages and proposals exist for sustainability and, most important, what threatens the reproduction of socioecological systems.

Environmental conflicts have been approached from several scientific fields, ranging from political science to economy or environmental sciences. Much of the literature has an expressed interest in promoting “security”, expanding “consensus” through institutionalized mechanisms of participation or increasing “resilience” to deal with change and allow the perpetuation of existing systems of reproduction. However, in many cases, environmental conflicts appear strongly related to issues of power and to the negletion of different languages of valuation by the economic and political hegemonies.

Ecological distribution conflicts are a specific type of environmental conflicts related to phenomena of ecologically unequal exchange. Most of these conflicts take place in rural areas. The Indian historian Ramachandra Guha, has described the conflicting rural populations as “ecosystems people”, since they are highly dependent on the natural environment for their survival. Constructivist approaches based on discourse analysis, have put in evidence that the values and languages carried by these groups are often expressed through conflict (see Guha, 1999; Martinez-Alier, 2002).

Martinez-Alier (2002) suggests that a large number of grassroots movements that emerged to oppose ecological distribution conflicts, express a specific language of valuation, which he calls “environmentalism of the poor”. In their expression, these movements tend to reject the dominant language of economic reductionism, pushing

forward languages of valuation that are weakly comparable, and therefore incommensurable and non-reducible into a monetary valuation system.

Research on the subject of environmental conflicts and security during the last two decades, has highlighted a set of distinct and apparently competing causes for conflict. These include the existence of resource scarcity, resource abundance, environmental change or degradation, identity conflicts or the intensity, direction and "ownership" of resource flows. However, there has been a lack of interlinking between these different explanation paths or narratives.

Environmental security approaches have been particularly vulnerable to scientific reductionism, possibly due to a dominance of political scientists which attempted to approach environmental issues by embeding environmental variables into the analysis of security issues. Some of these approaches have led to nearly racist Malthusian approaches to environmental problems, such as that of Robert Kaplan, a contributing editor of the Atlantic Monthly. In his article titled "The Coming Anarchy", Kaplan got inspiration on the early works of the political economist Thomas Homer-Dixon, to state that population growth and environmental degradation in the developing world were becoming a growing threat to the developed world. His view was an important influence to the political elites of many of the Western countries, but most notably among the United States "neocons" (see Englund, 1998), which probably meant that it was taken in the development of the 21st Century foreign policies of USA.

A few researchers approaching environmental security from other fields, have been critical of the simplistic views characterised by a strong ecological determinism and a complete lack of geopolitical sense. Among these researchers are the environmental scientist Jon Barnett, or the geographer Simon Dalby. Dalby (2002b) is particularly critical of the mainstream environmental security research, arguing that environmental security issues cannot be scrutinised without the geopolitical context in which conflicts take place. The works of Carrere & Lohmann (1996) and Lang (2008), relating the expansion of the pulp industry and tree plantations in the South to the world market dynamics, suggest that the geopolitical perspective is also of major relevance for understanding industrial afforestation conflicts. Schütz (2008) points out the limitations

of disciplinary scientific knowledge in addressing the complex processes related to the historical emergence of conflicts, related to industrial afforestation and its technological complex.

A major difficulty faced in an integration of the distinct analysis or narratives on environmental conflicts and security, has to due with the problems of communication between scientists or analysts coming from different backgrounds. This is an aspect that appears to be pretty weak in the majority of integrated analysis. While integrated analysis research has put substantial effort to escape reductionism (such as happens in cost-benefit analysis, with the transformation of all values into a single monetary scale) (Guimarães Pereira *et al.* , 2006), the road to a true integration of different languages of valuation has still a long way to go. Such an integration is necessary to provide an articulation - through complementarity or dialectical confrontation - of the different theories on conflict.

The languages of social scientists and natural scientists - both of which are important to properly comprehend the complexity of environmental conflicts or sustainability issues in general - create one of the most difficult divides across the history of modern science. In particularly, constructivism and realism are usually contradicting in academic research. However, a synthesis of both could present important scientific contributions and insights on environmental research (Metzner-Szigeth, 2009).

This thesis departs from the view that peoples' needs and desires are a construction. However, such construction results from coevolutionary dynamics, which means that the set of values and the language are largely shaped by the interrelations between society and nature (see, for example, the empirical analysis of Gonzalez *et al.* , 2009). In this perspective, discourse analysis can help in understanding conflicting values and possible options according to different groups of actors. However, the extent to which a certain group construction of a scenario is feasible (is there money? Is there land? Are there people?), just (who wins and who loses?) and sustainable (is the scenario stable on the long term? Will it result in the depletion of natural resources for future generations?) is often unclear.

This results from a lack of biophysical perspective in the conflicts literature. In

particular, the entropy law needs to be related with environmental conflicts, both within the analysis of the economic process (see Georgescu-Roegen, 1999) and in the comprehension of the dynamics of dissipative, far-from-equilibrium structures (see Prigogine & Stengers, 1984), which tend to resist the great transformations over history (see Polanyi, 2001).

Transparency is another issue faced in conflict mitigation approaches, as well as in different forms of participatory processes. Transparency is largely affected by the reclusion of the analyst/researcher in the office, to analyse discourses, define the problem and prepare the participatory approach. As participatory research becomes more and more focused on the implementation details of the process itself (Cleaver, 1999), these approaches increasingly provide technocratic managerial exercise of problem solving. Such a technocratic-centred participatory process is inevitably biased towards the world view of the analyst, with the consequence of potentially aggravating the conflicts. The problem is not solved by simply allowing the stakeholders to define solutions or scenarios within the participatory process. This happens because the process itself is structured to achieve a consensus which is anchored in a post-political condition that includes the "inevitability of neo-liberal capitalism as an economic system, parliamentary democracy as the political ideal, humanitarianism and inclusive cosmopolitanism as a moral foundation" (Swyngedouw, 2007). This post-political consensus, so deeply rooted in integrated assessments, participatory processes and conflict resolution, is best described by Žižek's following quotation (Žižek, 2000, p.198):

> "In post-politics, the conflict of global ideological visions embodied in different parties which compete for power is replaced by the collaboration of enlightened technocrats (economists, public opinion specialists, ...) and liberal multiculturalists; via the process of negotiation of interests, a compromise is reached in the guise of a more or less universal consensus. Post-politics thus emphasizes the need to leave old ideological visions behind and confront new issues, armed with the necessary expert knowledge and free deliberation that takes people's concrete needs and demands into account"

Within this post-political arena, conflicts are perceived as something bad, that

should be avoided. As a consequence, both research and policies focus on their resolution, either through state interventions to enforce security (including those which are market-related), or different forms of deliberative democracy targeted at achieving consensus. Most of the environmental security research (for example Homer-Dixon, 1991; Baechler, 1998; de Soysa, 2002b), is irreflexive and uncritical on the assumption that environmental insecurities happen when there are conflicts. However, why do the ruling elites usually want to avoid conflicts, while so many grassroots social movements extend their networks and influence to take part in conflict?

Unlike most environmental security research, political ecology has often approached this issue. Martinez-Alier (2002) suggests that environmental conflicts, particularly those concerning ecological distribution, can provide a positive path for sustainability. In fact, on many, if not most, social conflicts, there is a struggle for social or ecological justice which should not be disregarded. What opportunities for social and ecological justice are getting lost of silenced by forcing the direction of a post-political consensus?

Conflict analysis should, therefore, be able to understand and expose issues of power, while attempting to bring forward excluded identities, languages and values. This might even include the possibility of exacerbating of conflicts, by setting up a ground-playing level among all dissenting actors. Allowing the civil society to mobilize and express their dissent might open space for constructive creativity, while slowing down the pace of appropriation of ecological resources and the destruction of cultures by the economic system.

While political ecology reflects on power issues and therefore on the role of conflicts, it seems to be lacking the empirical, more quantitative and less context-dependent research that has been pretty developed within the environmental security literature. In fact, political ecology research often fails to upscale beyond the local, highly context-dependent analysis. Failure to navigate across scales brings an handicap in understanding larger-scale dynamics that are common to distinct conflicts across the globe. Even if some political ecology research tackles this at a qualitative level (for example Gezon & Paulson, 2005), it is still pretty limited in its capacity to relate

conflicts among each other and to understand the system dynamics which are behind sets of apparently unrelated conflicts.

Dalby (2002a, p.45) suggests that a look at intervening variables in environmental degradation and violence might help to better understand environmental conflicts under a diversity of circumstances. Due to the complexity of the phenomena involved in environmental conflicts, Gerber *et al.* (2009) propose that their understanding can be improved by linking elements of ecological economics with political ecology. More specifically, they suggest that social metabolic patterns across scales should be analysed and discussed within a political context.

This thesis focuses on the development of an analytical framework that attempts to deal with the abovementioned issues in conflict analysis and conflict resolution: reductionism, scalability, the constructivist-materialist between social and natural sciences, transparency and the post-political hegemony. The point of departure is Giampietro's multiple scale integrated assessment of social and ecological metabolism (MuSIASEM) (Giampietro, 2004; Giampietro *et al.* , 2009). MuSIASEM was conceived to address reductionism and problems of cross-scaling by relying on a characterization based on parallel and non-equivalent descriptions of social systems (originally agroecosystems) at different hierarchical levels. Furthermore, by using the framework of social metabolism and incorporating the concept of narratives, MuSIASEM also provides a good articulation between constructivism and materialism. The importance given to the pre-analytical development on what is the problem to be analysed, is an element that can provide transparency, depending on how the process is conducted by the analysts or decision-makers.

Despite all the virtues that can be attributed to MuSIASEM, it is important to have present that MuSIASEM was not originally developed as an approach to understand issues where the role of politics is central, such as happens with environmental conflicts. This resulted in an absence of reflection on the political within the MuSIASEM related research. In fact, a traditional interpretation of MuSIASEM, will see it as an approach for informing deliberative processes targeted at achieving consensus. However, I defend in this thesis that this approach can be used to escape the constraints of the post-political

hegemonic construction, through an articulation with political ecology. Section 2.4 (insights) presents proposals to develop a "political" MuSIASEM, capable of providing a useful and integrated conflict analysis.

Building a framework that deals with the complexities of environmental conflict analysis, opens the possibility to properly address the main research question of this thesis: why and how environmental conflicts emerge? More specifically, the thesis aims at understanding which system dynamics are behind the occurrence of environmental conflicts at a certain point in time.

To contribute to this understanding, the thesis develops an analysis of the political ecology of the eucalyptus expansion in Portugal, focusing on a particular historical case of environmental conflicts. During this period, the late 1980s, Portugal joined the European Economic Community. Major transformations were taking place in the country, leading to widespread rural conflicts (Caleiras, 1999). In order to provide an historical context where dynamics leading to conflict evolve or emerge, the window of analysis was extended to the period between 1980 and 2003.

The focus on a particular period in time and space, provides an empirical background to understand the evolution or emergence of metabolic patterns related to conflict. The application of a MuSIASEM approach to an *ex-post* case study, allows the exploration of evolutionary patterns of social metabolism across scales. Taking knowledge of such patterns of change can hopefully increase the quality of the decisions regarding the sustainability of agroecosystems, which are facing major pressures and changes all around the globe. Abstractions are developed by relating the empirical results with theories from the fields of environmental security, ecological economics, political ecology and complex-systems theory.

In summary, this thesis attempts to structure and make available metaphors to analyse the perceptions of stakeholders (the extended peer community), regarding proposed projects or policies and their potential pathways to conflict. Put another way, this thesis attempts to develop a meta-grammar for analysing environmental conflicts. The purpose of such meta-grammar is to provide a context-independent understanding of the system dynamics that are on the source of environmental conflicts. Due to its already

mentioned characteristics, it is aimed to be used by interdisciplinary research teams. It also attempts to provide a politically useful analysis - one that can actively expose social and ecological unjustices. It does so by allowing the analyst to structure the problem and look into it from the standpoint of affected or oppressed groups, many of whom express languages of valuation that situate outside the post-political consensus.

Figure 1.1 describes the structure of the research done in this work. It can be divided into four main clusters: background, pre-analysis, analysis and discussion. There is a strong emphasis on the pre-analytical phase, which is supported by a previous background research. The background research feeds an open information space with scientific literature review from different fields of research, together with the environmental history and institutional analysis of the case study which provide the analyst with the set of narratives. The environmental history was constructed by textual analysis of newspapers, as well as field observation and participatory research in three local studies. Institutional analysis was built from the literature review and semi-structured interviews with elements related to the pulp industry and the Government.

The pre-analytical phase ends with the construction of a relevant problem structure, which is then formalized into models and variables for analysis. In parallel, literature on environmental security and environmental conflicts is used to develop theoretical pathways, which serve as auxiliaries for the analysis.

The analysis was centred around representations of the models structured along the theoretical pathways. The discussion of the results followed a dialectical approach to sustainability. The dialectical discussion focused on the case study has provided a political ecology of the eucalyptus related conflicts in Portugal in the late 1980s. The interpretation of these results in articulation with the the theories and insights, within the wider context of ecological distribution conflicts, supported the construction of a meta-grammar for the analysis of environmental conflicts.

Figure 1.2 tries to distinguish elements in this thesis that come directly from a literature review, from those that constitute new contributions derived from the empirical and theoretical research. In the middle are contributions that are based on literature review, but reworked along the research, through an iterative process with the empirical

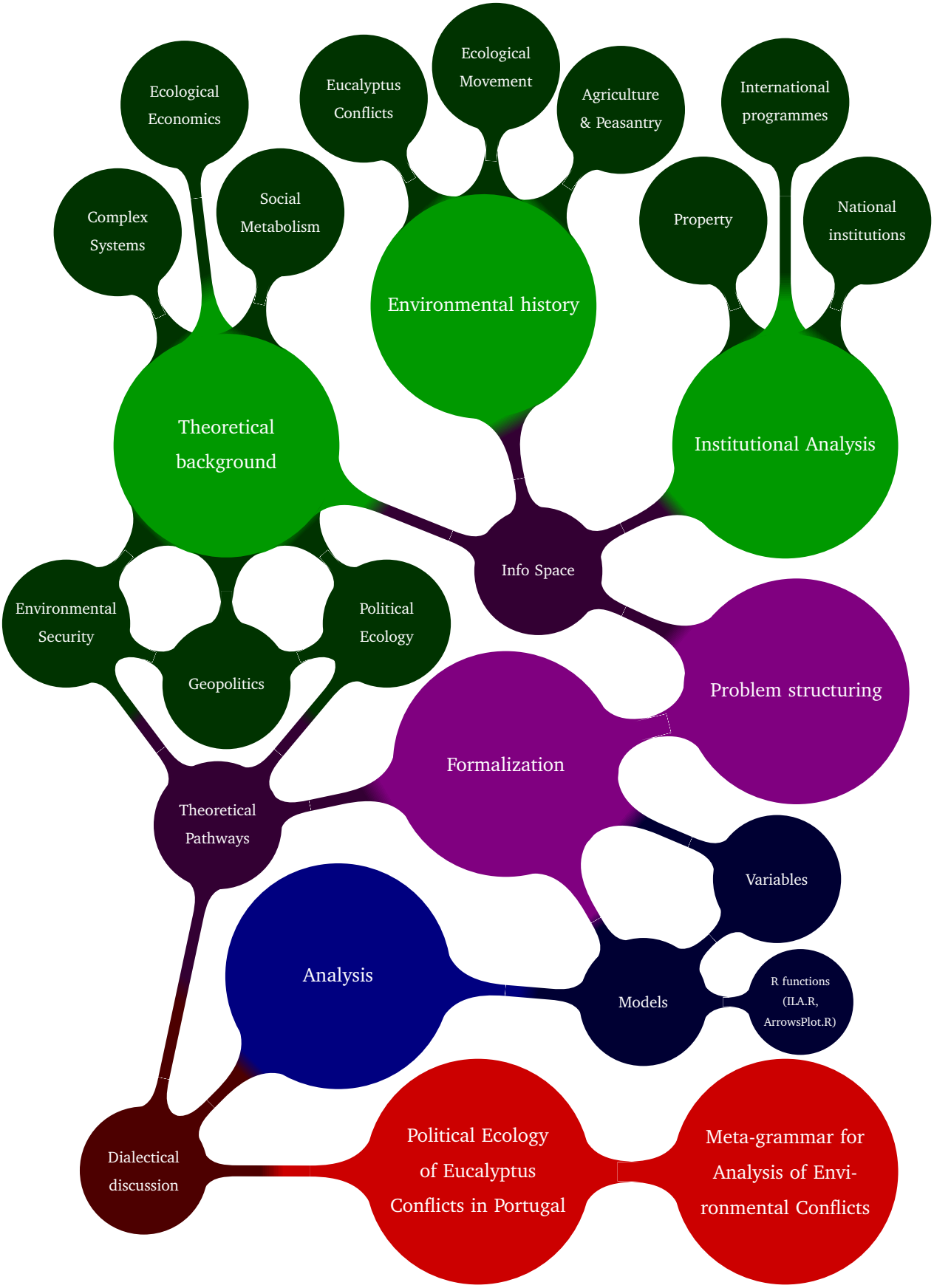

Figure 1.1: Research structure. Colors aggregate phases. Background: green; pre-analytical: violet; analysis: blue, discussion and outcomes: red.

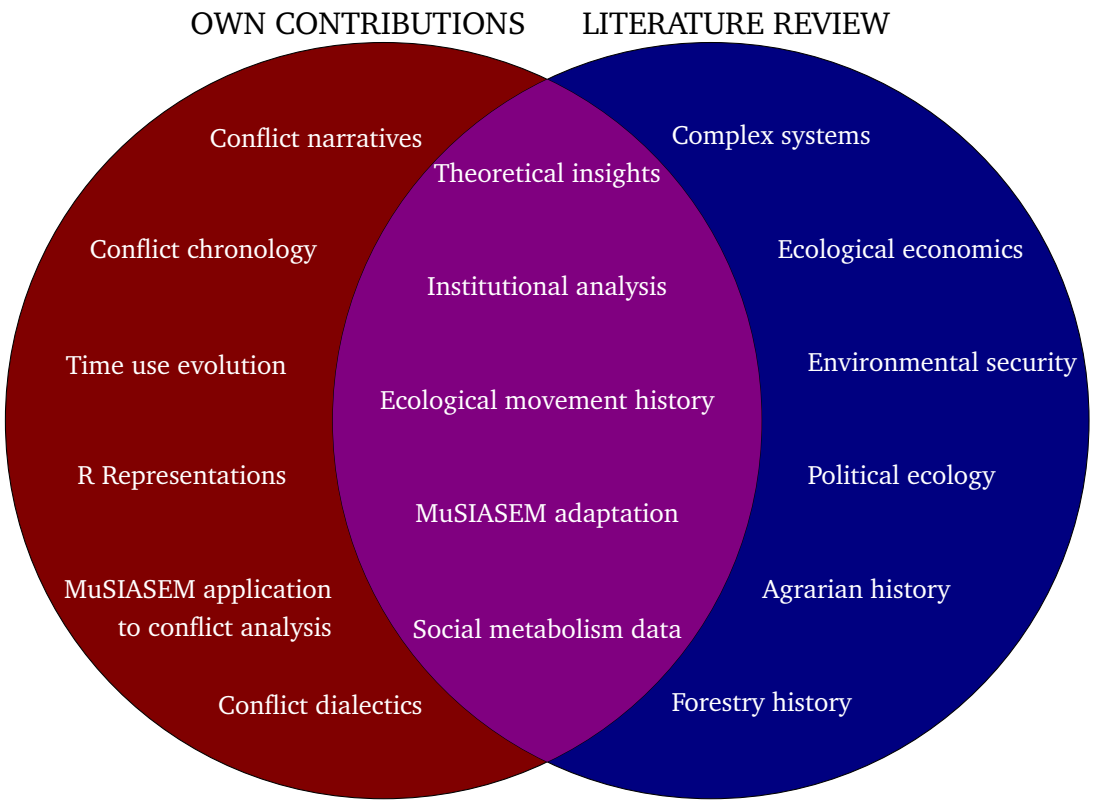

Figure 1.2: Overview of research contributions.

developments.

This thesis has been structured in three parts. The first part starts with the present chapter, which provided an introduction to the research, including the motivations, the methodological outline and the main research question. It is followed by chapter 2 on the theoretical foundations of the research, which includes the broad fields of complex systems, economics and environmental conflicts. Chapter 3 presents a construction of the environmental history related to the eucalyptus conflicts in Portugal that happened between 1985 and 1990. Chapter 4 develops an institutional analysis, which, together with the other chapters, form the background to the analysis.

The methodological developments and their application to the analysis of the eucalyptus related conflicts in Portugal are presented in the second part of the work. Chapter 6 highlights MuSIASEM approach adaptations, which were required to analyse the environmental conflicts in this thesis. This chapter should not be read as a comprehensive methodology of the thesis. The methodology used in this thesis is, at the same time, a methodological proposal for future research, consisting of an adaptation

of MuSIASEM to conflict analysis. To fully understand the methodology of the thesis, the reader should read through the empirical application described along part II.

Chapter 7 describes the pre-analytical steps, simultaneously applying them to the empirical case. These steps precede the analysis that takes place in chapter 8. Chapter 9 presents a dialectical discussion of the analysis, which can be read as a political ecological discussion of the eucalyptus conflicts in Portugal.

The conclusions are presented in the last part (III) of the work and relate to the different components explored in the whole thesis. The conclusions include sets of ideas and abstractions which might be useful for the analysis of other conflicts. They also suggest potential lines of future research.

All data sets used and processed in this research, as well as formulas and source code, are publicly available in open formats at http://phd.gualter.net.

Chapter 2

Theoretical foundations

2.1 Complex systems

> "You can not step twice into the same river"
>
> – Heraclitus of Ephesus (c. 535 - c. 475 BC)

> "We need not stop doing science when confronted with complexity. But it does change the way we look at science, and hence the way we look at crafts and technoologies associated with it"
>
> – Robert Rosen, Essays on Life Itself (2000, p.306)

2.1.1 History

According to Prigogine & Stengers (1984, p.104) the birth of the "science of complexity" dates back to 1811, when Baron Jean Joseph Fourier won the prize from the French Academy of Sciences for describing the process of heat propagation in solids. Some simple mathematics which described heat flow as being proportional to the gradient of temperature, was enough to create a law that describes a complex phenomenon that occurs in matter independently of whether it is in solid, liquid or gaseous state (Prigogine & Stengers, 1984). Dealing with the process at a molecular level, where the type of matter matters, would bring so much complexity to the the analysis and

understanding of the phenomenon that it would hardly become useful.

Thermodynamics appeared as a science which studies the result of the correlation between microlevel parameters such as pressure, volume, chemical composition and temperature. Thus, thermodynamics moves away from the point of view of classical mechanics, where the properties of particles rather than the system would be analysed. The following citation of Prigogine & Stengers (1984, p.106) makes clear the paradigmatic shift that is required when moving from the mechanical world to that of heat:

> "A *mechanical* engine gives back in the form of work the potential energy it has received from the outside world. Both cause and effect are of the same nature and, at least ideally, equivalent. In contrast, the *heat* engine implies material changes of states, including the transformation of the system's mechanical properties, dilatation and expansion. The mechanical work produced must be seen as the result of a true process of transformation and not only as a transmission of movement. Thus, the heat engine is not merely a passive service; strictly speaking, it *produces* motion. This is the origin of a new problem: in order to restore the system's capacity to produce motion, the system must be brought back to its initial state."

The evolution of this new "science of heat" eventually opened path to understanding the nature of irreversible process of heat dissipation (Prigogine & Stengers, 1984, p.105). The concept of irreversible process in physics contrasted with the world of Laplace, where a perpetual motion machine would have a place. Unless further energy is brough into the system, there is no way of reverting the system back to its original state. Time, as an absolute measure, gets its place back in science. The dissipation of heat and the arrow of time presented by thermodynamics destroyed the deterministic Laplace demon and, for the first time in the history of science, shaked the Newtonian science (Prigogine & Stengers, 1984).

The development of thermodynamics eventually led to the concept of entropy. This concept was proposed in 1865 by Clausius, after looking at the Carnot cycle from the perspective of the law of conservation of energy (formulated by Mayer in 1842 and Helmholtz in 1847) (Prigogine & Stengers, 1984, p.117). For the first time, there was a clear distinction between "«useful» exchanges of energy (...) and «dissipated» energy

that is irreversibly wasted" (Prigogine & Stengers, 1984, p.117). This distinction gave birth, in the 20th century, to concepts such as exergy or emergy. Exergy was first used by Zoran Rant in 1953, but developed into a multiplicity of forms to describe some kind of useful energy (Ulanowicz *et al.* , 2006). Emergy was coined by Howard Odum in the 1970s to describe "embodied energy".

The importance of processes and their irreversibility brought renewed attention to the concept of system. A system is an entity that represents more than the sum of its parts, since the entity entails irreversible processes. Ludwig von Bertalanffy made a first intent to develop a general systems theory in 1928. In the mid-1930s, Bertalanffy developed the open system metaphor, which inspired Prigogine to rebuild thermodynamics (Rosen, 1991, p.65). Other parallel developments included Lotka's development of populations dynamics in the 1920s and Norbert Wiener's publication on "cybernetics" in 1948.

Later in the 20th century, Checkland (1983, *cit* Mingers (2006)) defended a paradigm shift from hard systems. Soft Systems Methodology (SSM) was developed to deal with the impasse typical of science for governance regarding complex systems (Giampietro, 2004). SSM emerged from the dificulties of hard systems engineering to deal with "very messy problem situations in which no clear problem definition existed" (Checkland and Scholes, 1990, *cit* Giampietro (2004)).

2.1.2 Nature, ontology and epistemology

Rosen (2000, p.306) defines that a system is complex not due to the system itself, but due to the fact that it has nonsimulable models or impredicative models[1]. A special type of complex systems, which are called complex adaptive systems embodies the concept of self-referentiality (Rosen, 1991) or catalytic closure (Kauffman, 1995). Rosen (1991), considers a necessary condition for living systems, a type of complex adaptive systems, exhibit ternary set of functions, consisting of metabolic, repair and replication functions. In fact, this ternary set of functions can probably be applied to other types of complex

[1]Chemero & Turvey (2008) have argued that these impredicative models are actually Turing-computable, but the impredicativity characteristic of complex systems is maintained

adaptive systems, including social, economical and ecological systems.

Contrarily to simple systems, complex systems ontology and epistemology are different (Rosen, 2000, p.307). Epistemological plurality and ontological characteristics make complex systems exhibit multiple identities (Giampietro, 2004). Under the new paradigm proposed by Checkland, systems thinking became only related to epistemology, describing the "attribute" or "essence" of a system, rather than attempting to describe a system that exists in the world. As such, models describing complex system deal exclusively with the epistemology of the system (Rosen, 2000, p.281). Being independent from the systems ontology (where the system came from), a model does not necessarily produce a material system that is able to manifest that attribute (Rosen calls it the realization of the model) (Rosen, 2000, p.281). This puts the analyst in face of a challenge, which is how to develop a formal system capable of describing the systems ontology. In fact, the Incompleteness Theorem of Gödel, showed that it is not possible to achieve a formalization that coincides with the whole set of truths about numbers (Rosen, 1991, p.7). Rosen (1991, p.6) argued against the formalistic mathematics school of Hilbert and Rutherford's "hardness" and quantitation in science. He states that semantic truth - the actual referents to a word - can never be fully replaced by syntactic rules - the rules to manipulate manipulations of the word between propositions.

A problem that results from this limitation on describing complex systems is that nonequivalent observers will have different views over the same reality (Giampietro, 2004). Their different backgrounds or position in regard to the object will make them build one specific formalization, that cannot possibly encompass the whole set of values (truths) of other observers. In the words of Giampietro (2004, p.380), "many human agents, which are relevant because of their decisions, always represent an unknown context of other human agents". One particular aspect of this multiple identities is related to scale. An hierarchical system can be characterized by operating on multiple spatiotemporal scales, meaning that different process rates take place within the system (O'Neill, 1989 *cit* Mayumi (2001)).

To be able to observe nested hierarchical systems over different levels, one must use different detectors and typologies of pattern recognition (Giampietro, 2004). For

example, one cannot look at cells using a telescope and look at stars using a microscope. Giampietro (2004, p.32) builds on the hierarchy theory by Allen and Starr (1992), to propose the use of the concept of holarchy, developed by Koestler in 1969, to describe a class of hierarchical systems "made up of self-organizing (dissipative) adaptive (learning) agents that are organized in nested elements". These elements are called holons, to make explicit their double nature of whole and part.

The issues related to complex systems are far from being properly acknowledged and dealt with by the majority of decision-makers and scientists. Strand (2002) considers that "modern societies are characterized by a belief in the strategy of reducing practical problems to a set of technical problems to be handled by the appropriate institutions and expertise". By ignoring and thus making invisible a range of uncertainties, knowledge grows on ignorance, ultimately leading to conflicts and impacts generated by badly informed decision-making processes (Wynne, 1992). Strand (2002) describes this predominant "simple view" as "uncertainty in background information and in the outcome of the chosen policies", that is "expressed as quantitative risk and managed in a rational way by risk-cost-benefit analysis". This leads to a divide between the politician, which decides on the issues of value, and the expert which should be able to develop his technical plans inside a set of values previously defined by the decision-maker. Even when complexity is, to some extent, recognized, it is often based on a "thin complexity" view, where prediction and control of the system are possible sometimes, since it involves a system with rich connections and non-linearity far from equilibrium, which leads to uncertainty (Strand, 2002). Rational governance would then require a critical attitude toward the quantification of uncertainty in terms of risk (Wynne, 1992). However, as Rosen (1991, p. 17) described, only acknowledging uncertainty, or even ignorance, is not sufficient, since "a fact or datum, by itself, is essentially meaningless; it is only the *interpretation* assigned to it that has significance" (emphasis from original). Only a "thick complexity" view (Strand, 2002), that acknowledges the indeterminacy inherent to a non-reducible set of identities, can be capable of describing complex systems in a relevant way.

The problem led some authors to suggest proposals that are able to deal with the uncertainties and complexity of policy-related science. Such is the case of postnormal

science proposed by Silvio Funtowicz and Jerome Ravetz, marking a position away from Kuhn's positivism in his analysis of the formation of "normal science" (Prigogine & Stengers, 1984, p.307). As with the soft systems methodology of Checkland, postnormal science takes by granted that there are multiple perspectives available to describe any holon (Giampietro, 2004):

> "A number of purposeful holons in the form of models of human activity are represented in the form of systems which are named, modelled, and used to illuminate the problem situation. This is done by comparing the models with perceptions of the real part of the real world being examined. **What is looked for in the debate is the emergence of some changes** which could be implements in the real world and which would represent an accomodation between different interests. (...) Which selected "relevant" human activity systems are actually found to be relevant to people in the problem situation will tell us something about the culture we are immersed in."
>
> – Checkland and Scholes, 1990, p. 30, *cit* Giampietro (2004)

Funtowicz & Ravetz (1993) justify a postnormal science approach when both the decision stakes and the uncertainties are high, leading to an inneficacy of traditional methods of analysis or decision-making. "Extended peer communities", "consisting not merely of persons with some form or other of institutional accreditation (stakeholders), but rather of all those with a desire to participate in the resolution of the issue" should be created to take such approaches (Ravetz, 1999).

Munda (2004) argues that the existence of multiple identities in complex systems allows a distinction between the concepts of social incommensurability and technical incommensurability. Under this divide, Funtowicz & Ravetz (1993) post-normal science and Munda (2004) social multicriteria evaluation (SMCE) would be addressing social incommensurability, by dealing with the multiplicity of legitimate values in society. Checkland (2000) soft systems methodology, on the other hand, is dealing primarily with technical incommensurability, which Munda (2004) relates to "the multidimensional nature of complexity and refers to the issue of representation of multiple identities in descriptive models".

Giampietro (2004) considers that reductionism can only be superseeded by continuous shifting between semantic and formal models, an idea similar to the continuous feedback between natural systems and formal systems described by Rosen (1991). This means being able to develop metaphors to share the meaning about a situation (definition of classes of models) and translating such meaning of the perceptions associated with a class of models in relation to a specific situation to generate data related to variables which can be used as indicators (Giampietro, 2004). In the words of Giampietro (2004, p.376), "a metaphor makes it possible, when studying a given system at a given point in space and time, to infer conclusions, guess relations and gain insights only by taking advantage of analogies with other systems about which we have preliminary knowledge". The concept of using metaphors, which Giampietro retrieves from Rosen (1991, p.64), is directly addressing the issue of technical incommensurability.

Giampietro *et al.* (2009) proposes a multi-scale integrated assessment of societal and ecosystem metabolism (MuSIASEM, originally proposed as MSIASM), which will be described later on this document. By attempting to "properly perceive and represent a process of becoming which is taking place across different scales", also addresses social incommensurability to some extent (apart from the anchorage to Munda's SMCE in Giampietro (2004)). It does so by emphasizing the importance of a preanalytical phase that should structure the problem in an appropriate way. This problem structure is considered to be a prerequisite to generate a useful set of models. Furthermore, Giampietro (2004) argues that the quality of the problem structuring depends on the capacity of the analyst to describe the set of legitimate views that are part of the information space for a specific problem. This requires addressing three different problems (Giampietro, 2004, p.107):

1. exploring the variety of legitimate non-equivalent perspectives found among the social actors (especially relevant for normative purposes);
2. generating the best possible representation of the state-of-the-art knowledge relevant to the decision to be made (especially relevant for descriptive purposes);
3. trying to find a fair process of aggregation of contrasting preferences and values (crucial to have a fair process of governance).

Funtowicz & Ravetz (1993) concept of extended peer communities could help to define the boundaries of the set of legitimate views for a specific problem. Being able to integrate the narratives of this extended peer community pertaining to a certain activity or project, would then become a precondition to develop an appropriate problem structure and, consequently an useful set of models, capable of supporting quality analysis or decisions. This in turn enables analytic representations of the sustainability trade-offs, in relation to the set of defined legitimate views and the option space (Giampietro, 2004). Social incommensurability and technical incommensurability are simultaneously tackled by the MuSIASEM.

2.1.3 Function and models

When studying complex adaptive systems, one should be aware that there will always be a large amount of ignorance and indeterminacy. This happens because they are becoming systems, due to their self-organization, openness and far-from-equilibrium state (Prigogine & Stengers, 1984; Giampietro, 2004). In short, not only is difficult to characterize the present state of the system, it is basically impossible to objectively predict the future states of the system.

Giampietro (2004, p.32) stresses that the concept of holarchy in itself should be able to preserve "a valid mapping between a class of organized structures (e.g., a population of individual organisms belonging to a species) and the associate functions (e.g. the set of functions related to the ecological role of the species)".

(Rosen, 2000, p.337) characterizes the modelling relation of complex systems as a congruence between two systems of entailment. The mathematical, model, as a system of inferential entailment, has to be made congruent with the real-world system of causal entailment. This requires being able to step away from the system itself and referring it to its environment (Rosen, 1991, p.248). While the elements of a mechanism represented in an abstract block diagram appear unentailed, organisms will exhibit maximal entailment. This means that "if f denotes a component of such a system, the question «why f?» has an answer, in terms of efficient causation, within the system"

(Rosen, 1991, p.249).

A question can then be posed, from the new perspectives brought by entropy: if dissipation of energy is an inevitability in non-isolated systems (dissipative structures) why do we observe so much stability all around us? The answer can, as Rosen argued, be found within the system, in terms of efficient causation. Kauffman (1995, p. 49) calls a collectively autocatalytic system ”one in which the molecules speed up the very reactions by which they themselves are formed”. A whole network of self-propelling loops, Kauffman argues, will be able to constantly re-create itself, as long as there is enough energy in the form of food molecules.

Kauffman (1995) catalytic closure is similar to the findings of Prigogine & Stengers (1984) in the analysis of far-from-equilibrium and both suggest that living systems, which are dissipative structures, are not an improbable event, as used to be argued. In 1984, Niklas Luhmann applied the same concepts of self-referentiality to social theory. Luhmann, applying the concept of autopoietic systems by Maturana and Varela to social systems (Fischer-Kowalski & Weisz, 1999), argued that self-organization happens through self-producing communications, allowing the system to continuously reproduce itself as long as there is dynamic communication (Fuchs, 2006). Sieferle, considered culture as an autopoietic system, “consisting of recursive communication and differentiated into various subsystems (Fischer-Kowalski & Weisz, 1999). Anthony Giddens and Pierre Bordieu provide alternative versions of self-organization in social systems, by considering as dialectical the relationship of social structures with social pratices or actions (Fuchs, 2006).

In formal terms, contrarily to machines or simple systems, complex systems have closed loops of entailment (Rosen, 2000, p.280). These loops are manifested by impredicativities or self-references. Giampietro (2004, p.171) proposes the use of impredicative loop analysis, relying on heuristic models, in order to deal wit the chicken-egg problem posed by these closed causal loops that appear in complex adaptive systems. ”Impredicative loop analysis provides a common relational analogy (a typology) of self-entailment among the values taken by parameters and variable - used to characterize parts and the whole - within a standardized representation of autocatalytic loops“

(Giampietro, 2004, p.376)

Chemero & Turvey (2008) disputed Rosen (2000, p.24) statement that this type of systems, precisely because of their impredicativity, could not be computed by finite-state machines, like the Turing machines. By relying on hyperset theory, Chemero & Turvey (2008) argues that it is possible to build computer models for studying "non-fractionable, circularly causal, partly semantic systems such as Rosen's metabolism repair system".

One important feature of impredicative loop analysis is the capacity to understand the constraints and option space of a system or holarchy. More specifically, it provides a proper understanding of the system option space by allowing the simultaneous observation of two types of constraints, holonomic and non-holonomic. The holonomic constraints, identified by Schrödinger, pertain mostly to configurational variables, that is, they result from the interaction of the system with the external environment (Rosen, 1991, p.97). Holonomic constraints define the holonomic or rigid structure that gives rises to phenotypical traits Rosen (2000, p.16). On the other hand, non-holonomic constraints involve both configuration variables and their rates of change, which are internal to the system under analysis. Since they are not easily expressed in tidy functions, they have been much less studied that holonomic constraints (Rosen, 2000, p.15).

Building relevant models cannot be decoupled from the previously mentioned problem structuring. Rosen (2000, p.43) distinguishes between complicated models and complex models. An adequate problem structuring, that is capable of answering the relevant question of analysis, is crucial to avoid developing a meaningless complicated model (Giampietro, 2004). Fourier did approach this issue in his description of the law of transfer of heat, by mentioning in an apparent antagonism, that a complex systems most useful analysis is one which brings up a simple understanding (Prigogine & Stengers, 1984).

One of the main challenges of trying to model complex systems is that "the increased complexity of the models might lead to slipping into thinking in terms of models of part of the real world, rather than models relevant to debate about change in the real

world (Checkland and Scholes, 1990, p. 40, *cit* Giampietro (2004)). Giampietro (2004) used the expression "complicated models" to describe models where a large number of variables, parameters and nonlinear dynamics come into play without helping to deal with the complexity of the analysed system. Since the model is merely representing a given shared perception (or holon, in the words of Checkland and Scholes), not a description of part of the real world, it is essential that some quality control is made to assess whether the intellectual construct is adequate or valid for the specific problem situation. Under this view, "models are only a means to an end which is to have a well structured and shared representation of the perception of a problem situation to be used in the debate about how to improve it." (Checkland and Scholes, 1990, p. 43, *cit* Giampietro (2004)). As such, while models can predict reasons for instability due to system changes, pointing to the existence of critical bottlenecks, they cannot predict whether such an instability will translate into phenomena such as conflicts (Giampietro *et al.* , 2010b).

2.1.4 Agroecosystems

Agroecosystems are considered a particular type of adaptive complex system. They can be seen as cybernetic systems which aims at generating increased social value (Conway, 1987). The definition of agroecosystem is usually linked with the concept of agroecology (Giampietro, 2004), proposed by Miguel Altieri in 1987 (Altieri, 1989). "Modern agriculture", usually related to the "Green Revolution" is, in face of the new concept of agroecology and the study of agroecosystems, not more than a set of reductionist approaches to the way society produces food. Its main indicator is often a monetary quantification and the main objective is the increase of productivity, achieved through the use of artificial nutrients, irrigation and mechanization.

Giampietro (2004) considers that efforts to represent and understand agroecosystems do not require the creation of any radically new tools, but instead to develop new packages for already existing tools. However, it must deal with a few significant systemic problems brought by a self-organizing system. First of all, it is necessary to acknowledge that it is impossible to formalize a procedure for what could be considered

a sound analysis. Such analysis will certainly be dependent on the context (what type of agriculture is practised and what is the cultural background of the farmers?), on the objectives (what needs to be improved and for whom?) and on the observer (what is the political background of the observer and with whom does he communicate better with?).

An additional problem relates to human diversity: there will always be divergence of opinions and, as such, no pre-built consensus on the issues (Giampietro, 2004). The analyst will therefore have to deal with these contrasting legitimate views, not to forget that he has to decide on what is or not legitimate, if any opinions are to be excluded at all. The "unavoidable occurrence of non-equivalent observers", as Giampietro (2004, p.98) calls it, means that:

1. there will be disagreements about the basic goals and strategies among the actors;
2. an agroecosystem can be described using different and logically independent indicators of performance;
3. human systems redefine extremely fast what is desirable and acceptable.

This leaves the analyst in face of unavoidable uncertainty and ignorance in the analysis (Giampietro, 2004). However, many optimization models which simplify the system into a single descriptive domain (most of the times money of energy) end up externalizing the losses or impacts outside of the analysed boundaries (Giampietro, 2004). This "epistemological cheating" (Giampietro, 2004, p.100) can only be avoided by representing the performance of agriculture using different criteria, which reflect the different values and goals, as well as different hierarchical levels, containing a mix of non-equivalent descriptive domains. This involves including more than just the production of crops and animal products in the mix of relevant activities considered in the analysis. Considering the economical and biophysical productivity in the analysis is also not enough to deal with the problems of incommensurability, uncertainty and ignorance in the management of agroecosystems. Rather, the sustainability of agricultural systems requires the management of conflicts within processes that are capable of dealing with complex systems (Giampietro, 2004, p.370).

2.2 Oikonomia

"At its heart, a living organism is a system of chemicals that has the capacity to catalyze its own reproduction."

– Kauffman (1995, p. 49).

"No science has been criticized by its own servants as openly and constantly as economics. The motives of dissatisfaction are many, but the most important pertains to the fiction of *homo economicus*. The complaint is that this fiction strips man's behavior of every cultural propensity, which is tantamount to saying that in his economic life man acts mechanically. This is why the shortcoming is ordinarily exposed as the mechanistic outlook of modern economics. The criticism is irrefutable. However, the mechanistic sin of economic science is much deeper than this criticism implies. For the sin is still there even if we look at the economic process from the purely physical viewpoint only. The whole truth is that economics, in the way this discipline is now generally professed, it mechanistic in the same strong sense in which we generally believe only Classical mechanics to be"

– Nicholas Georgescu-Roegen, *The Entropy Law and the Economic Process* (1971)

2.2.1 Value

Since 1870, neoclassical economists attempted to be socially neutral and considered value and price to be equal (Martinez-Alier, 2004b, p.338). Freud's concept of fetishism, as the construction of an excessive image only valued by its worshippers, inspired Marx to conceptualize commodity fetishism. Commodity fetishism, a value that is artificially created over a certain commodity, derives from the dificulty of signifying value (Mulvey, 1993).

One of the most problematic issues with capitalist economies is that it constantly requires new territories and increases the times of production (Martinez-Alier, 2004b, p.276). The radiologist Frederick Soddy had noted already in the early 20th century the antagonism between economical time and the pace of nature set by geochemical and biological times. The first flows at a fast pace, as a result of capital flows and

arbitrary interest rates, leading to an irreversible destruction of nature and of cultures which expressed different values their resources differently. Therefore, putting market prices on spaces that still haven't been commodified, switches the times of production, opening a path where economical time takes over the ecological time (Martinez-Alier, 2004b, p.276).

Giampietro (2004, p.379) considers that the exclusive use of the economic narrative by neoclassical economists also tends to ignore the existence of constraints, both internal (culture, ethical values or technological capacity) and external (availability of material and energy inputs from the environment as well as the possibility of safe disposal of wastes). This leads to a view that resources and technological advance are limitless and that the substitution between environmental and economical goods or bads is possible.

In fact, many of the problems of neoclassical economics appear related to the merge of oikonomia and chrematistics, following the concept of the invisible hand of Adam Smith. The distinction between oikonomia - the art of managing the house - and chrematistics - the art of making money - was originally made by Aristotle (Martinez-Alier *et al.* , 1998). While Aristotle considered that chrematistics was able to partially contribute to oikonomia, Adam Smith understood that, in fact, his invisible hand was capable of transforming all wealth into well-being.

The neoclassical economist perspectives on valuations have been brought into the field of environmental economics. Environmental economists try to account for negative environmental externalities as well as positive environmental services through monetary valuation. While negative environmental externalities can be included in neoclassical economic theory by making distinction between social and private marginal costs of production and extraction, this economical valuation will always be dependent from the relative incomes and power relations (Martinez-Alier, 2004a, p.277). Conventional calculations of agricultural productivity are also criticized by Martinez-Alier (2004b, p.192), for not incorporating chemical contamination, genetic erosion and energy and materials inputs, leading to a wrong pricing of exhaustible resources. These include the famous Hubbert's peak oil (Deffeyes & Silverman, 2004) and the

more recent debate on peak phosphorus (Abelson, 1999; USGS, 2007).

Faber (2008) considers that mainstream economics, by viewing nature as a subsystem of the economy, lacks the capacity to deal adequately with nature, justice and time. Padilla (2002) notes the specific problem of intergenerational justice posed by conventional economic analysis, which rely on the use of arbitrary discount rates in order to be able to put into a single dimension present and future costs and benefits.

In terms of trade, the theory of comparative advantages of Ricardo (1821) argued that every part would benefit in a trade relation if they would specialise in productions which would be internally cheaper. An example given by Ricardo was the case of England specializing in cotton production and Portugal in wine production. Both countries would then benefit in trading their specialized production. Critics have pointed out that this specialization path could mean to become attached to certain patterns of production that excludes the increases in productivity from scale economies (Martinez-Alier, 2004b, p.274). Current knowledge of environmental externalities puts further questioning into Ricardo's differential rent theory.

Farrell (2007) further explores the issue of environmental valuation, by arguing that environmental values and valuation are coevolutionary. She presents a critique of monetary valuation, while addressing monetary unit-based environmental valuation methods. Her worst case scenario exposes the problem of a "vicious cycle of increasingly self-referential adaptations in the evolution of future value articulation methods" would produce "increasingly meaningless environmental value data". Such a valuation system would lack the capacity to correct itself due to a semantic decoupling with the objects of valuation (Farrell, 2007).

Another issue in relying on reductionist valuation has been exposed by Martinez-Alier *et al.* (1998). The authors distinguish between the concepts of strong commensurability, weak commensurability and weak comparability. Comparability means the ability to have a "common measure of the different consequences of an action". The difference between strong and weak comparability relies on the type of measurement (cardinal for strong, ordinal for weak) used to bring valuation to a single scale. On the contrary, weak comparability assumes that there are conflicting values which are

unavoidably irreducible. However, they are compatible with rational choices, through the employment of practical judgements (O'Neill, 1993).

In face of a weak comparability, commensurability of values becomes an oxymoron. It is not possible to properly compare apples and oranges by the means of setting a price on them (Martinez-Alier, 1991). The issue of incommensurability, leading to the impossibility of an economical rationality and of the aggregation of value into a single scale, brings Martinez-Alier (1991) to conclude that economy is always driven by politics. Several political scientists have expressed their concern on the current post-political order, which lies on the idea that consensus and win-win solutions are always possible, that in fact are only possible among those sharing the values of the hegemony Laclau & Mouffe, 2001; Žižek, 2000; Swyngedouw, 2007. Possible escapes from the post-political order include Söderbaum (2007) proposal that individuals and organizations should be understood respectively as Political Economic Persons and Political Economic Organizations, or the recognition that without conflict and division, rather than rational consensus (expressed by authors such as Giddens or Beck), constitute the basis of pluralist democractic politics (Laclau & Mouffe, 2001).

2.2.2 Material

The criticism of the economist Nicholas Georgescu-Roegen to "the mechanistic sin of economic science" led him to develop one of the most important works of economy in the 20th century. In his book "The Entropy Law and the Economic Process, Georgescu-Roegen attempts to extend the revolution brought by the science of heat, to the field of economics (Georgescu-Roegen, 1999). Being "an admirable epistemologist", Georgescu-Roegen was able to introduce the idea of "entropic indeterminateness", together with emergence of novelty, as qualitative changes, in the study of evolutionary structures, as are economical systems (Mayumi, 1995). He argued that the analysis of such qualitative and, in particular, structural changes, requires a dialectical approach (Mayumi, 1995). The work of Georgescu-Roegen would eventually gave birth to Ecological Economics, whose practicioners Faber (2008) considers to be bound by their interest in dealing with issues of nature, justice and time.

However, the work of Georgescu-Roegen in bringing a biophysical approach to the economy is not the first in history. In 1840 the chemist Justus von Liebig's was the first to understand the role of soil nutrients in a book titled "Organic chemistry and its application to agriculture and physiology" (Foster, 2004, p.230). In this work, Liebig introduced the Law of the Minimum, based on a principle developed by the German botanist Karl Sprengel. It states that growth of plants is controlled not by the total of resources available, but by the scarcest resource. Marx was already pointing out in the decade of 1860 that the differential rent theories advanced by the economists James Anderson (1801) and Ricardo (1821) could not have considered the real causes of land depletion (Foster, 2004, p.230), since there was still no knowledge on soil nutrients and their relation to crop production.

Joan Martinez-Alier tends to disagree on Foster's idea that Marx developed the basis for a biophysical economical analysis. Marx, he argues, was unable to divide between the use of energy in nutrition (endosomatic) and the use of energy by tools (exosomatic), which is required for an understanding of human ecology (Martinez-Alier, 2007b). Martinez-Alier & Naredo (1982) point out to that the work of Podolinsky was one of the first to do a proper energy accounting in agriculture. Podolinsky wanted to contribute to Marxist theory, despite being more related to narodnism (Martinez-Alier, 2003). However, he failed to convince Marx and Engels about the relevance of the concept of entropy developed by Clausius for the economic process. As a consequence, Marx was not acknowledging the existence of decreasing returns in agriculture, through a belief in Liebig's agricultural chemistry and the promise of artificial fertilizers (Martinez-Alier, 2007b). The significance of the rejection of Podolinsky's ideas by Marx and Engels is one which is still in debate (Martinez-Alier, 2003; Foster, 2004; Burkett & Foster, 2006; Martinez-Alier, 2007b).

Inspired by the writings of Boulding (1966) on the threat of our "cowboy economy" to "spaceship earth", natural scientists started to develop approaches to study the material and energetic flows between societies and their natural environment (Fischer-Kowalski & Weisz, 1999). Robert Ayres pioneering work in industrial ecology is considered one of the founding stones of material and energy flow analysis. Ayres (1978) considered the economy to be "a system of transformations that convert raw

materials and natural resources (both renewable and nonrenewable) into ”final“ goods and services”. The transformations are unidirectional, moving from the extraction of resources, to processing, consumption and discarding as wastes (Ayres, 1978).

Economy-wide material flow analysis is becoming increasingly a standardised data collection and analysis procedure at the EU level and has been applied to several countries and regions across the world (Bringezu & Schütz, 2001; EUROSTAT, 2002; Bringezu *et al.* , 2004; Niza & Ferrao, 2006; Weisz *et al.* , 2006). Several studies have related material flows with land use (Giljum & Hubacek, 2001; Schandl *et al.* , 2002; Krausmann *et al.* , 2004). However, Martinez-Alier (2004b, p.278) notes that physical reductionism should as well be avoided, as it suffers from the same problems of incomensurability. He gives the example of the complementary use of concepts such as emergy by Odum and exergy by Hornborg.

Norgaard (1989) proposes moving away from the reductionist, one pattern thinking of the dominant trend in economics, by relying on methodological pluralism, using the broad range of methodologies available in the disciplines of ecology and economics. Ecological economists have embraced methodological pluralism, generating a broad range of legitimate and valuable fundamental philosophical positions, a condition that Baumgärtner *et al.* (2008) consider necessary to ecological economics. Methodological pluralism is particularly good in dealing with the incommensurability of plural values: economic, social, cultural, physical and ecological (Martinez-Alier, 2004b, p.339). Together with the recognition of a weak comparability of value, methodological pluralism puts ecological economics in a substantially different path from environmental economics, both regarding decision making and economic valuation.

2.2.3 Metabolism

Coming from the social sciences, Marina Fischer-Kowalski proposed the analysis of societal metabolism as a framework that could be approached both by social and natural sciences Fischer-Kowalski & Weisz (1999). Inspired by the work of Sieferle addressing the issue of cultural evolution of the society-nature interrelationship, Fischer-Kowalski

& Weisz (1999) considered society to be an hybrid between the material and symbolic realms. Due to the role of the cultural system in defining the material system relevant to society, the boundaries of society are historically variable (Fischer-Kowalski & Weisz, 1999). As such, only after having an "adequate knowledge of the (materially delimited and finite) system that is to be reproduced" becomes "possible to assess the material and energetic flows required for the maintenance of the system in question" (Fischer-Kowalski & Weisz, 1999).

According to Fischer-Kowalski (1998), Marx and Engels were the first to apply the concept of material metabolism (*Stoffwechsel*, which literally means the exchange of materials) to society, deriving it from Moleschott's and other physiological materialists description of metabolism as exchanges of matter between an organism and its environment (Fischer-Kowalski, 1998). However, Martinez-Alier (2007a) considers that Mayer had pioneered in 1845 the use of *Stoffwechsel* in relation to energy flows. Podolinsky's energy analysis of agriculture, as already mentioned in the debate between Foster and Martinez-Alier, is also considered a percursor of social metabolism related analysis (Martinez-Alier, 2007b). Patrick Geddes, a biologist and urban planner, proclaimed the emancipation of society from monetarism and developed calculations of energy and material flows that could provide an alternative framework to evaluate all economic and social activity (Fischer-Kowalski & Weisz, 1999; Martinez-Alier, 2007b).

Within the social metabolism framework, many theoretical and empirical developments have been made in the last decades. The works on industrial ecology or "industrial metabolism" (Ayres, 1978; Martinez-Alier, 2007a) were of particular relevance to the development and mainstreaming of material flow analysis. Researchers have pushed the methods and applications of material flow analysis to the analysis of the energy flows of society (Haberl, 2006). Human appropriation of net primary production (HANPP) has been a particularly developed indicator, relating energy in the form of net primary production with land use and the impacts to biodiversity (Haberl *et al.* , 2004a). HANPP has been calculated at the global scale (Haberl *et al.* , 2007) and recent developments include attempts at estimating an embodied HANPP which relates the impact to the places of consumption of biomass (Erb *et al.* , 2009). Material and energy flow analysis (MEFA) have been applied for historical analysis of countries (for

example Austria by Krausmann & Haberl (2002) and Krausmann *et al.* (2004)). More recently, the analysis of social metabolism started to be applied to international trade, addressing issues of environmental load displacement, ecologically unequal exchange (Martinez-Alier, 2003, 2007a; Weisz, 2007) or the role of international policies and institutions in land use changes (Scheidel & Krausmann, 2011; Wicke *et al.* , 2011).

Inspired by the fund-flow model of bioeconomics of Georgescu-Roegen (1999), Giampietro *et al.* (2009) developed a particular framework for the analysis of social metabolism. The illusion of win-win scenarios, Giampietro (2004, p.370) argues, frequently comes together with a scaling error or a one-sided perspective, since policies of technological changes never bring absolute improvements. The trade-offs become visible when looking at changes using different scales and different descriptive domains, which is part of the multi-scale integrated analysis of societal and ecosystem metabolism (MuSIASEM) (Giampietro, 2004; Giampietro *et al.* , 2009) that will be followed in later parts of this document. By acknowledging the multiple scales of complex systems it allows the understanding of internal and external constraints.

In the representation of farming systems, the same ideas of incommensurability should be brought in order to have a proper understanding of the system dynamics. Farming systems are operating within two nonequivalent contexts, the socioeconomic context and the ecological context (Giampietro, 2004, p.369). Such representations, even if they can be based on typologies of farming systems - such as the smallholders characterized by Netting (1993) -, must include the specificities of their own history and local ecological and cultural constraints (Giampietro, 2004, p.369).

The Danish economist Ester Boserup claimed that farmers will not undertake tasks that they have no need to (Boserup & Kaldor, 1965). Their decisions are based on whether they can fulfil their needs with the available land and the existing regime of production. Boserup & Kaldor (1965) confronts Malthusian approaches that population growth is dependent on agricultural production. By assuming that people resist labour and therefore agricultural practices which require additional work (Abernethy, 2005), she argues that it is rather population trends which determine agriculture developments (Boserup & Kaldor, 1965). Whenever land is not enough, creativity and effort of farmers

is put into place to intensify the production.

Abernethy (2005) points out that Boserup's view, while creating an important point of departure from conventional agricultural economics, fails in recognising the environmental impacts of agricultural intensification. While agricultural expansion was slowed in the 20th century, agriculture productivity has increased at an unprecedented rate, through crop breeding, chemical fertilizers and pesticides, irrigation and mechanization (Matson *et al.* , 1997). Specialization in the production process, with the widespread of monoculture crops, has resulted in a reduction of biodiversity in agroecosystems, which can affect the renewal processes and ecological services (Matson *et al.* , 1997; Altieri, 1999). The transformations in the food production systems brought by the Green Revolution have also led to an increased energy use and therefore to a less efficient production which can become problematic in the presence of energy crisis (Pimentel *et al.* , 1973). As such, a farming system forms a complex network of constraints on the use of time, land and energy, which evolves hand in hand with the cultural and economic characteristics of the societies which build up these systems. Giampietro *et al.* (2010b) consider that dealing with such complex metabolic systems require quantitative analysis.

Smallholder agriculture, being the main component of the non-capitalist forms of production, is particularly important to ensure the reproduction of industrial work (Hespanha, 1994). Despite having a major dependency of market, which limits its range of options, smallholders continue to have "enough autonomy to interfere with the development of the social relations of capitalist production and even block them through the social relations that generates within it" (Santos, 1985:878 *cit* Hespanha (1994)). Agricultural pluriactivity is not only a result of the transformations that market and capital generated in the peasant reproduction mode, but also, on the contrary direction, in the conditions that capital has had to strive to impose itself (Hespanha, 1994). The rural population follows what Boaventura Sousa Santos has called a "logic of enlarged survival", which consists in a widespread concern for the preservation of the domestic group cohesion, the autonomy of the labor process and an equilibrium between work and consumption (Hespanha, 1994).

The transition from an agricultural subsistence society to industrial capitalism was considered by Polanyi (2001) as the greatest transformation that society ever faced and. He argues that such transformation did not happen without volition. The existence of conditions to buy agricultural machinery, for example, required a whole change in the motives of action of the members of the society. The idea of subsistence was replaced by that of gain, as for the machinery to be produced work and materials needed to be bought; and for these factors to be paid, the agricultural activity must have had to bring profit to the farmers (Polanyi, 2001).

Polanyi (2001, p.38), contrarily to other economists of his time (such as H. de B. Gibbins, Innes or Gairdner) highlighted the positive effects of the interventions in the economic system by the the Tudors and early Stuarts. While others have classified such "protective enactments" as doing more harm than good, Polanyi (2001, p.40) considered that by using the power of the Crown, they have managed to slow down the deep economic transition brought by the enclosures to a point that it became "socially bearable". In the centre of Polanyi's critique, was the fact that it is not enough for a transition to bring future economic improvements (even if they are, in fact, occurring). What is relevant is how the time-rate of change compares with the time-rate of adjustment - if change supersedes adjustment, then problems arise. Polanyi (2001) argued that state intervention was useful to moderate the rate of change. That is, even if interventionist measures might not be able to define the direction of change, laws and rules are certainly determining how much change is allowed to take place and at which pace.

2.3 Environmental conflicts

> "For a long time turbulence was identified with disorder or noise. Today we know that this is not the case. Indeed, while turbulent motion appears as irregular or chaotic on the macroscopic scale, it is, on the contrary, highly organized on the microscopic scale. The multiple space and time scales involved in turbulence correspond to the coherent behavior of millions and millions of molecules. Viewed in this way, the transition from laminar flow to turbulence is a process of self-

> organization. Part of the energy of the system, which in laminar flow was in the thermal motion of the molecules, is being transferred to macroscopic organized motion"
>
> – Ilya Prigogine and Isabelle Stengers, "Order out of Chaos - Man's New Dialogue with Nature" (1984), p. 142

2.3.1 Political ecology and environmental security

Seeing nature in relation to history and as a cause of political outcomes is at least as old as the works of the classical greek thinker Aristotle (Deudney, 1999). The iluminist Charles de Montesquieu, in his work *L'Esprit des Lois* (1748) declared that the "empire of climate is the first and greatest empire" (Deudney, 1999).

In modern science, Friedrich Ratzel, a German geographer and ethnographer working at the University of Liepzig, is considered to be the first to link geography to natural systems, thus giving birth to the field political geography. In doing this, he moved away from a static conception of borders (which he considers very volatile due to conflicts) to an organic and growing definition of states. The organism to study is no longer the state but the land in its spiritual bond with the people who draw sustenance from it. The expanse of a state's borders is a reflection of the health of the nation. In 1897, Ratzel published the book *Politische Geographie*. Particularly important was his essay of *Lebensraum* (1901), a term that can be translated as "living space". Rudolf Kjellén, Swedish pupil of Ratzel would further elaborate on organic state theory and who coined the term "geopolitics".

After World War II, social scientists have increased their tendency to neglect natural variables, favouring human institutional and historical variables. This was in part the result of a discrediting of geopolitical theories brought by the use of the deterministic Ratzel's theories in the construction of the Nazi *geopolitik* (Deudney, 1999), particularly by the hand of General Karl Haushofer. Haushofer adopts the view that borders are largely insignificant in his writings, especially as the nation ought to be in a frequent state of struggle with those around it. Ratzel's idea of *Raum* would grow out of his organic state conception.

While nature was being pushed out of social sciences, historians such as Fernand Braudel, William McNeill, Alfred Crosby and Geoffrey Barraclough were bringing into history material variables to help them describe patterns of regional and global history (Deudney, 1999). For example, Braudel described ”structures“ of *longue durée* as the realities of ”man in his intimate relationship to the earth which bears and feeds him“ (Laughlin, 1994; Deudney, 1999).

Deudney (1999) describes geopolitics or *physiopolitics* (from the word *physis*, meaning nature in Greek) as ”the subset of functional-materialist theories focusing on variations in the nonhuman physical environment that shape human *political* outcomes“. This functionalism derives from anthropological naturalist assumptions about naturally given human needs, such as food or energy, and capacities, such as land or time, which define a set of constraints for social activity. The objective of it is to show how natural independent variables (such as land, water or population), which are not controled by humans, influence human institutions (Deudney, 1999). Norgaard (1994, p. 59), on the other hand, considers that geopolitics is also highly influenced by culture. This coevolutionary perspective on geopolitics is not distant from perspectives of Immanuel Wallerstein and Fernando Braudel, which see society and its geographical milieu as operating in a symbiotic relationship. While this idea relates to classical Marxism, it departs from it by placing geopolitical relationships in at least the same level of importance in understanding the development process. Wallerstein is even stronger in defending the importance of geopolitical analysis, by considering geopolitical relations between places as agents of change and major determinants of historical development (Laughlin, 1994).

In 1972, the anthropologist Eric Wolf introduced the expression Political Ecology. Wolf is one of the most famous references in what regards peasant conflicts, particularly with his book Peasant Wars (Wolf, 1971). As an assumed Marxist, Wolf focused much of his analysis of peasantry in the struggle of classes that originated from different models of development. The anthropologist Robert Netting further developed political ecological analyses of farming systems (Netting, 1993), although he was not focused on the phenomenons of social conflicts (Martinez-Alier, 2004b, p.104).

Piers Blaikie was pioneering a political ecology analysis of social conflicts in the 1980s (Gezon & Paulson, 2005; Forsyth, 2008). By targeting the social dynamics of land degradation, Blaikie and Brookfield analysed the evolving relations of social structures and the use of the environment, by looking at aspects of power, property, work and knowledge among different classes, casts and gender (Martinez-Alier, 2004b; Gezon & Paulson, 2005). His writings denoted a departure from a Marxist and eco-catastrophist epistemology, moving towards an identification of social justice influenced by critical realism, post-structuralism and participatory development (Forsyth, 2008).

The anthropologist Peter Brosius described the existence of two styles of Political Ecology, based on the materialism/constructivism divide (Martinez-Alier, 2004b, p.322). The constructivist approach relies on discourse analysis, while the materialist approach consists of a fusion of Human Ecology with Political Economy and focuses on resource demand and access among different power actors. Martinez-Alier criticizes constructivist approaches to political ecology, which are developed in ”sofa seminars about political-ecology-and-cultural-theory” focused on discourse and meanings across cultures, while lacking empirical proofing. However, he argues that a connection between both materialist and constructivist approaches to discourse is possible and useful to relate languages of valuation with issues of power and rights over resources - struggles for resources have always been also struggles for meanings. In fact, the discussion on environmental valuation is one which links Political Ecology to Ecological Economics (Martinez-Alier, 2004a, p.322).

It was not until the fall of the Berlin Wall that nature mainstreamed among academics as an important driving force of human political institutions (Deudney, 1999). The concept of environmental security has emerged in the security debate after the end of the Cold War (Barnett, 2003), tracing a parallel development to that of political ecology in the analysis of social conflicts. In 1992, two politically influential books exposed visions of a new post-cold war world order. Francis Fukuyama’s “The end of history and the last man“ presented the world with an end of history narrative, with the ultimate success of liberal democracy and capitalism. Samuel Huntington book “The clash of civilizations“ was, on the contrary, pointing to new emerging large-scale civilizational conflicts and divides. Dalby (2002a) considers that Huntington was

oversimplifying Ratzel's theories, by largely ignoring the interlinking of geographies. Huntington thought that the great divisions of mankind were cultural, rather than defined by borders, ideologies or economies.

In 1994, the journalist Robert Kaplan[2] became famous among Washington politicians with his alarming and visually appealing predictions of a "coming anarchy" (Kaplan, 1994). This article was written after a journey that started in West Africa for looking how the growing population and environmental problems were becoming a major problem for the security of the modern world. In line with Thomas Malthus propositions, Kaplan assumed that resources will be in shortage in part because global population would grow faster than the ability of agriculture to support it. Kaplan's new world appeared "linked to cultural and racial clashes, geographic "destiny" and the transformation of warfare" (Dalby, 2002a, p.29). He builds his ideas from the emerging environmental security literature, in particular from Homer-Dixon (1991) article "On the Threshold: Environmental Changes as Causes of Acute Conflict". In his own interpretation of the article, where he embodies the concepts of Hegel and Fukuyama's "Last Man" and Hobbes "First Man", Kaplan (1994) points out that we are entering in «a bifurcated world». Part of the globe is inhabited by "us", the "Last Man", «healthy, well fed, and pampered by technology». On the other part, the degrading South, Hobbes's "First Man" are «condemned to a life that is "poor, nasty, brutish, and short". Although both parts will be threatened by environmental stress, the Last Man will be able to master it; the First Man will not». Kaplan suffered, as Huntington, from a lack of geopolitical sense. Despite disagreeing with the overall broad divisions of Huntington, which he considers innacurate, Kaplan is still focused on a division between identities defined by cultures. On the other hand, Kaplan also considers that identities are often diffused over territories. Under the title «the lies of the mapmakers», he writes about the development of his «healthy skepticism toward maps, which, I began to realize, create a conceptual barrier that prevents us from comprehending the political crackup just beginning to occur worldwide» (Kaplan, 1994).

[2]It is important to note that Kaplan is not a researcher, but a journalist. His inclusion in the literature review is justified by the enormous influence that his article has among the political elites of many of the western countries, most notably among the United States "neocons"

Around the turn of the century, as a result of detailed field work and research on the relationships between environment and security, this type of "ecowars" alarmist discourse has been dismissed (Dalby, 2002b). It became quite consensual among different approaches on environmental security that the resource factor interplays with culture, religion and different anthropological, social and economical aspects in the development of conflicts.

The debate on environmental security, both on its meaning and on the causes of unsecurity is, however, far from being consensual. A particular source of the variety of meanings and approaches to security lies in the different backgrounds of the researchers. On one side, were political scientists, which attempted to embed environmental variables into the analysis of security issues (such as Homer-Dixon (1991); Baechler (1998); Deudney (1999); de Soysa (2002b)). From the other side, political economists and geographers such as Simon Dalby (Dalby, 2002a) and environmental scientists like Jon Barnett (Barnett, 2003) were criticizing classical approaches for understanding of security, while proposing more complex environmental considerations involving different spatial scales. As a result, while the former tend to address threats to national security, the latter tend to focus on the human impacts on the security of the environment itself (Barnett, 2003, p.12).

In parallel, political ecological research, which began with the work on local case studies by rural anthropologists and geographers, started to expand to other fields of research and to wider geographical focus. This has provided a better understanding of ecological distribution conflicts, relate to the "social, spatial and temporal patterns of access to the attainable benefits of the environmental resources and to the services supplied by the environment as a life support system" (Martinez-Alier, 2004b, p.104). For example, Hornborg (1998, 2007) brought political ecology to the framework of world systems theory (Wallerstein, 2007) and relies on environmental history to analyse environmental change and ecological distribution conflicts; Adger *et al.* (2001) analysed the relation between global environmental discourses, dominated by a technocentrical worldview, with local actors and policies; and Escobar (2006) proposed a political ecology framework to analyse conflicts over natural resources, which are increasing as a response to neoliberal globalization.

Despite these recent developments in the field of political ecology, it still focuses mainly on local social conflicts and, in particular, misses the relation between the environment and core concerns of political science such as regime security and armed conflicts (LeBillon, 2001).

2.3.2 Natural resources

The discourse of ”neo-Malthusians” such as Kaplan (1994) appear closely related with the Toronto school of Thomas Homer-Dixon, which explores the role of scarcity in the emergence of violents conflicts. They tend to see population growth as an important driver for violent conflicts, because they lead to a scarcity of natural resources. With the development of the research on environmental conflicts, the Toronto School has moved a step away from an almost deterministic relation between resource scarcity and conflict. More recent works have acknowledged a construction of scarcity which is dependent on a complexity of social processes. These include increasing demand (which is still strongly related to population growth) or decreasing supply of resources, as well as issues of control and access to resources by different groups (Homer-Dixon, 1999, p.48). The last aspect emphasizes situations of elite control over productive resources, in a process called ”resource capture“ (Homer-Dixon, 1999, p.74). Resource capture can happen because of a powerful group’s fear of disadvantage in face of rising scarcity or simply because of greed. This process can result in the displacement of peasants and subsistence farmers, which Homer-Dixon describes as ”ecological marginalization“ (Homer-Dixon, 1999, p.78).

These developments did not, however, release the Toronto school from its approach to resource scarcity. Homer-Dixon (1999, p. 136) divides violent conflicts in three types, but all of them end up being related to resource scarcity:

- **Scarcity conflicts**, explained by general structural theories (such as game theory).
- **Group identity conflicts**, explained by group identity theories, often arising from large-scale movements of populations, partially pushed by environmental scarcity.

- **Insurgencies**, explained by a combination of relative-deprivation theories and structural theories of civil strife. Insurgency "is a function of both the level of *grievance*, motivating challenger groups and the *opportunities* available to these groups to act violently on their grievances"

A contrasting perspective relating resources to conflict is developed by the Peace Research Institute of Oslo (PRIO) (de Soysa, 1999, 2002b; Lujala *et al.* , 2005). de Soysa (1999) focused on post-Cold War patterns of conflict with a focus on agriculture, accounting for both the causes and consequences. The researchers found that violence over resources in the South occurs in the struggle to control abundant resources that have an high market values and can generate high revenues to the exploring group. Empirical research made by other authors gives at least partial support to this theory. Lujala *et al.* (2005) found a relation between the production of secondary diamonds and ethnic war, which became more intensive in the post-cold war era. Ross (2004) correlated oil extraction with the likelihood of conflict, while 'lootable' commodities, such as gemstones and drugs, appear correlated with the lenght of conflicts, suggesting that they are used to support the costs of war by conflicting factions.

Other authors (Fearon, 2005; Di John, 2007) claim that there is no relevant link between primary commodity exports and violent conflict. These authors defend that the apparent correlation of conflict with oil producing countries has to do to low state capabilities for the level of per capita income. Ross (2004) also found no correlation between primary commodities and civil war. He argues, however, that this is because primary commodities consist of a broad category which includes oil as well as agricultural commodities, which did not correlate with conflict in his analysis.

Some authors (Buhaug & Rød, 2006; Østby *et al.* , 2009) claim that this lack of correlation is also related to the geographical focus of the analysis. While the explanations for the occurrence of civil wars involve factors which vary within states (such as ethnic discrimination, wealth inequalities, or core-peripheries divides), the statistical data is aggregated at the level of the country (Buhaug & Rød, 2006). Homer-Dixon (1999, p.144) also acknowledges this problem, using it to justify the lack of correlation between the use of societywide averages of indicators (such as GDP/capita

or educational levels) to measure of relative deprivation and civil conflict. Recently, Østby *et al.* (2009) tried to address this issue by coupling geographically referenced survey data on measures of regional performance with records on conflict zones and natural resources related variables.

Some authors (Mehlum *et al.* , 2006; Brunnschweiler & Bulte, 2009) are critical of these correlations between indicators of resource stocks or flows and violent conflict. Brunnschweiler & Bulte (2009) claim that resource dependence is endogenous with respect to conflict, since conflicts are responsible for increasing resource extraction. This perspective actually appears to be pretty coherent with the correlation found by Ross (2004) between 'lootable commodities' and civil war. Mehlum *et al.* (2006) observes an interplay between resources and institutions. These studies suggest the existence of a circularity of entailment and make regression analysis problematic.

2.3.3 Environmental change and resilience

A broad group of researchers (Baechler, 1998; Matthew, 2001) relate violent conflicts with human-induced environmental change, particularly when it affects the peripheries or the socially disfavored. The Environment and Conflicts Project (ENCOP), led by Günther Baechler constitutes probably one of the most extensive research efforts in this direction, comprising forty area studies. It focus on the interrelationship between concepts of environmental degradation, maldevelopment and violent conflict. Baechler (1998) specifically defines environmental conflicts as "traditional conflicts *induced by environmental degradation*" (*emphasis* added). Human-induced environmental change is then related with a condition of social and political "maldevelopment", which appears strongly coupled with the disruptions of modernity on peripheral areas.

The resilience framework is a conceptual framework used for the assessment of social and ecological thresholds. Researchers on resilience often approach the problems of environmental change and the capacity of adaptation. Socio-ecological resilience is strongly attached to the panarchy theory of Holling (1986). Panarchy is a term used to describe a concept that explains evolution within complex adaptive systems (Holling,

2001). Holling considers that ecological, human and other combined systems constitute an hierarchical structure, interlinked in never-ending adaptive cycles of growth, accumulation, restructuring and renewal.

Applying the panarchy concept to socio-ecological research and particularly to the study of environmental conflicts, provides interesting insights. For example, the concept of "thresholds" or "tipping points" (Walker & Meyers, 2004; Walker *et al.* , 2004), can help in understanding the outbreak of conflicts as a result of environmental stress or resource demand. Transformability, defined as "the capacity to create untried beginnings from which to evolve a new way of living when existing ecological, economic, or social structures become untenable" (Walker *et al.* , 2004) might entail the potential for environmental conflicts.

Fraser *et al.* (2003) builds on Amartya Sen's entitlement theory to describe vulnerable communities as presenting lack of entitlement options, due to social and economic isolation, together with an high level of dependency on the natural environment - particularly if this environment is also vulnerable itself (Fraser *et al.* , 2003).

Blaikie (2006) critical analysis of community-based natural resource management on which much of the resilience scholars focus, relates their disappointing outcomes with the lack of interfacing betweeen donors and recipient states, as well as between the state and the management at local level. Hornborg (2009) has recently criticized the resilience framework, for lacking perspectives of power, conflict, and contradiction, but also of culture, particularly at a wider geographical level. This issue is particularly relevant in face of the importance of geopolitics of consumption and resources in the global economy Dalby (2002b).

2.3.4 Ecological distribution and geopolitics

On one particular type of conflicts, those of centre-periphery, the research of Baechler (1998) has noticed a clash between capital intensive global companies and identity groups dependent on natural capital and with low or no commercial energy input, particularly when the area has no integration into the market economy. The main

capitalist projects that catalyse an escalation of these centre-periphery conflicts seem to be large cash crop farming projects, dams and mining (Baechler, 1998). From an historical perspective, colonial and post-colonial relations between countries and regions have supported the growth of European and North American economies, while displacing peoples and disrupting economies in other parts of the world (Dalby, 2002a, p.61). Increased resource consumption and its global geographic differences, related with the paths of history, act as a driving force for conflicts by bringing pressure over resources (Dalby, 2002a; Barnett, 2003). Such considerations are completely absent from neo-Malthusians such as Kaplan (1994), who divides the world into the developed "us" versus the marginal and violent "them". However, as was previously discussed, they have also been missing from other authors approaches to environmental security, environmental change and resilience.

Madrav Gadgil and Ramachandra Guha described an ecological-situation framework derived from their empirical work on "landscapes of resistance", where "ecosystem people" struggle against the threat of resource exploitation by "omnivores" (Gadgil & Guha, 1995; Guha, 1999). Gadgil & Guha (1995) characterize ecosystem people, which constitute four-fifths of India's rural people, as being highly dependent "on the natural resources from a limited resource catchment" and with "very limited access to human-made capital". Omnivores, is a term derived from the patterns of consumption (high consumptions of fish and meat) of a part of the population, which assures its supply through a resource capture of the entire biosphere (Gadgil & Guha, 1995, p.35)

Dalby (2002b) attempted to place Gadgil and Guha's framework - applied by the original authors to local conflicts in India - to a more generic global context of environmental conflict analysis. The concept of "omnivores" is mapped to the Northern patterns of consumption, while "ecosystem people" are mostly related to the global South. The expansion of the market system, together with the increasing transfer of resources to the omnivores, threatens to displace ecosystem people, transforming them into impoverished ecological refugees. Displaced people become migrants, often landing in burgeoning Southern cities where they, too, become part of the urban economy that the expanding commercial agriculture sector must feed (Dalby, 2002b). Urbanization leads to an increasing dependency on resources and food supplies from rural areas. In

a context of rapid globalization, the displacements of rural, marginal people, leave the economy increasingly dependent on oil (Dalby, 2002b). Such increasing oil dependency in face of declining reserves (peak oil) is expected to lead to further conflicts and resistance to the expansion of oil exploration frontiers (Orta-Martínez & Finer, 2010).

Urban omnivore elites assure their continuous flows of resources through historically founded power inequalities which allow them to make or influence policy decisions regarding the use of natural resources and the depletion of wastes in any part of the world (Dalby, 2002b). The increasing gulf between omnivores and the dispossessed, mostly formally ecosystem people, has been widening, leading to ever more acute conflicts Gadgil & Guha (1995, p.96). The issues of power and unequal access to resources have been approached by several authors at the theoretical level and, more recently, through empirical studies.

Dalby (2002a, p.157) argues that control approaches to security are used to favour the dominant global system. However, reinforced state control and overexploitation of local resources from the peripheries contributes to the development of new insecure constituencies, which can be a source for conflict. Ecologically unequal exchange and environmental load displacement further facilitates the consumption levels of more economically developed countries, by rendering the impacts of production invisible in the consumption centres (Jorgenson & Rice, 2007). Unequal exchange is a concept that has been applied to the exchange of goods of products through trade, where the value of work or health is undervalued among the poor (Martinez-Alier, 2004b, p.274).

Martinez-Alier (2004b, p.274) traces the origins of such ideas to geographers like Raumoulin, which has put forward in 1984 the term *Raubwirtschaft*, or plunder economy. With the ecological vision of an open economy relying on the natural environment, theories of ecologically unequal exchange have been developed (Hornborg, 1998; Martinez-Alier, 2004b). Examples of ecologically unequal exchange include the export of oil from the Niger delta, where power and market relations are hugely disproportionate; the diamonds from Africa or copper and gold from Peru which go together with a non-internalized ecological rucksack (Martinez-Alier, 2004a, p.214); or the export of shrimps from Thailand which accounts as a major factor for the destruction

of mangrove ecosystems (Barbier & Sathirathai, 2004).

Hornborg (1998) relates the problem of ecologically unequal exchange to international trade itself. He considers that ”a major rationale of international trade is precisely the transfer of energy and other resources from peripheries to centres of accumulation”. For Martinez-Alier (2002, p.214), ecologically unequal exchange translates as “the fact of exporting products from poor regions and countries, at prices which do not take into account the local externalities caused by these exports or the exhaustion of natural resources, in exchange for goods and services from richer regions”. However, Martinez-Alier (2004b, p.104) considers that many of the ecological distribution conflicts take place outside the markets and that orthodox economical approaches “undercover“ ecological distribution conflicts by using nomenclatures such as ”externalities” or “market failures” and relying on subjective, often incommensurable economic valuation.

Ecologically unequal exchange is usually backed by poverty and lack of political power of the exporting region, together with factors such as a lack of exporting options, the lack of internalization of externalities in export prices or the lack of application of the precautionary principle to products with technologies that have yet to prove their safety (Martinez-Alier, 2002, p.214). Under an historical analysis, the lack of exporting options can be traced to the recommendations, policies and enforcements of some international financial institutions. Relying on the idea of comparative advantages, they promote outward strategies of development that have led countries to specialise in resource-intensive or environment-intensive products. Muradian & Martinez-Alier (2001) calls this a “specialisation trap“, where the terms of trade for the primary sector are constantly being deteriorated, in particular when there are attempts to increase production, leading to an oversupply of natural resources. On the other hand, environmental load displacement of pollution-intensive sectors, undermines the opportunities of development of Southern countries, as they suffer the environmental load of Northern consumption patterns (Jorgenson & Rice, 2007).

Muradian *et al.* (2002) have proposed the analysis of the ecological or environmental terms of trade to assess the distribution of environmental loads when countries engage in trade. The concept of terms of trade was central in the Singer-Prebisch

thesis, which has been subject to debate in development theories. The Singer-Prebish thesis postulates that primary commodities prices tend to decline in comparison to manufactured prices. As a consequence, a country which specializes in primary exports will tend to have disadvantageous terms of trade in comparison to countries which specialize on manufactured goods or do not specialize at all. Muradian *et al.* (2002) takes inspiration from the ”pollution terms of trade” index developed by Antweiler, to develop an indicator of environmental terms of trade. The fundamental distinction brought by the concept environmental terms of trade is that it uses physical instead of monetary flows, avoiding the problems related with the idea of a weak comparability of values. ETT is thus defined as “the total entailed environmental pressures in exports in relation to the total entailed environmental pressures in imports” (Muradian *et al.* , 2002).

More recently, empirical works such as Jorgenson & Rice (2007), Muradian & Giljum (2007) and Weisz (2007) have found that both environmental load displacement of intensive-pollution sectors and ecologically unequal exchange are taking place around the world. Rice (2007); Jorgenson & Rice (2007) have relied on the concept of ecological footprint and environmental space. Nations with higher consumption usually experience lower levels of some forms of environmental degradation such as water pollution or deforestation (Jorgenson & Rice, 2007). To be able to understand whether there a displacement of the impacts of consumption in nations with larger ecological footprints was taking place, Jorgenson & Rice (2007) developed an indicator, “weighted export flows”, which includes a measure of the proportion of exports multiplied by an attribute of the receiving country (in his case, GDP per capita). This indicator appeared highly correlated with the ecological footprint of less developed countries. Rice (2007) has concluded that international trade promotes an appropriation of the environmental space of lower and middle-income countries, by high income countries.

2.3.5 Values, identities and expressions

The rapid flows of capital and interest rates are much faster than the rhythms of nature and of the cultures of ecosystem people that co-evolved with it. The previously

mentioned antagonism between economic time and geochemical and biological time is leading to an irreversible destruction of nature and of cultures that express different values over their resources. In 1944, Karl Polanyi's book "The Great Transformation" was precisely pointing to the new pace brought to society by the Industrial Revolution, leading to "a catastrophic dislocation of the lives of the common people" (Polanyi, 2001, p.35). Despite this, some mainstream conventional security discourses are still stuck with the idea that modernity and technological development must be exported or implemented in the poorest regions of the world. However, Dalby (2002a, p.158) points out to the contradictions that exists between this discourse for worldwide modernity and the resulting impoverishment and disruption in certain places of the global economic system.

Environmental conflicts have to be seen not only as conflicts of interests, but also as conflicts of values (Martinez-Alier, 2004a, p.318). D'Alisa *et al.* (2010) empirical study on the waste conflicts in Campania (Italy) provides support to Alier's argument. D'Alisa *et al.* (2010) considers that governmental intervention and repressive laws to avoid protests against waste facilities have oversimplified the complexity of the crisis by silencing the expression of different values and languages. Such an intervention can be situated in the post-political arena (see Swyngedouw, 2007) and effectively impedes an effective resolution of the conflict.

Joan Martinez-Alier has proposed the use of the term "environmentalism of the poor" to describe a type of ethics or attitude that is characteristic of groups affected by an unequal ecological distribution (Martinez-Alier, 2002). Such trends have been identified mostly within Southern countries, but are also visible in peripheries within Western countries. Examples include the environmental justice movement born among ethnic minorities in the United States (Martinez-Alier, 2004b, p.28); or social strata or geographies within a country, such as the expression of local populations against waste co-incineration in cement kilns in Portugal (Matias, 2004). Carrere & Lohmann, 1996, p.87 have proposed that the effect of resistance movements opposing the deleterious expansion projects of the pulp industry is highly dependent on the capacity to have a global reach. The capacity of these movements, which express an "environmentalism of the poor", to supersede the distance to the consumer, has become particularly strong

in the last decade, with the emergence of new media and internet activism in different forms of citizen journalism, such as autonomous news websites, blogging or crowd sourced cartography (Kahn & Kellner, 2004; Liu & Palen, 2010).

Martinez-Alier (2004b, p.27) argues that the impacts denounced by these movements, are affecting in a disproportionate way some social groups in the Southern countries. It is the demand for social justice and the right to access their own natural resources, which are essential for sustaining their lives, that leads these groups to react, sometimes in the form of conflicts. They are different from other groups in Southern countries, which struggle, for example, to defend sacred trees; the environmentalists of the poor can be characterized by a materialistic approach to the environment on which their livelihoods are based.

A predominant archetype of Southern groups "environmentalists of the poor" are peasants and indigenous groups. These groups have frequently had a long coevolutionary history with their natural environment (Martinez-Alier, 2004b, p.27). Through this, they not only achieved the conservation of biodiversity, but also became highly dependent on their complex human-nature systems, which are well described in some of the agroecology literature . Martinez-Alier (2004b) considers that many of these groups express a form an eco-narodism or ecological neo-narodnisim. Narodnism is a political current that arose in Russia after the emancipation of the serfs in 1861 (under Emperor Alexander II), which signalled the coming end of the feudal age in Russia. The Narodniks believed the peasantry was the revolutionary class that would overthrow the monarchy, regarding the village commune as the embryo of socialism.

The commercialization of agriculture, resulting from the spread of the capitalist mode of production, was particularly important in transforming the rural society. A parallel effect of modernization was the induction of class consciousness among the affected, leading to increased rural unrest against the transformation of their ways of life (Dalby, 2002b). In fact, many farmers or peasants movements, particularly in the South, have been struggling against the threats to traditional agriculture. They exhibit a new consciousness, opposing the doctrines of economic development and productivism from agribusiness companies and many governments (Martinez-Alier, 2004b, p.188).

Wolf (1971, p. 291) distinguishes different types of peasants and considers that only two types of peasants have the "internal leverage" to take part in rebellion. One is a "middle peasantry", which refers to a peasant population with secure access to land of its own and cultivating it with family labour - the core of the definition of Netting (1993) smallholders. Wolf notes that "there are differences in behaviour and outlook between tenants and proprietors, between poor and rich peasants, between cultivators who are also craftsmen and those who only plow and harvest, between men who are responsible for all agricultural operations on a holding they rent or own and wage labourers who do their work under supervision of others in return for money" (Wolf, 1971, p. xv).

As a class, middle peasants have more freedom of movement than poor and landless peasants, while still being independent from the rural elites that have control over land policies. Although this peasantry stratum is usually identified as "the main bearers of peasant tradition" , they are also the most vulnerable to economic changes (Wolf, 1971, p.292). Poor peasants located in peripheral areas, away from landlord control, can also have the potential to rebel. The key issue for having potentially uprising peasants, is related with the capacity to withold from the power of superior hierarchies and take possession and control of their own resources. In short, to be "free" peasants. Apart from land, other income generating activities that are relatively independent of land, such casual labor, smuggling or livestock raising might provide some "latitude of movement" and material resources to survive the disruptions caused by social unrest (Wolf, 1971, p. 291).

Middle peasants present yet another interesting characteristic which is their capacity to establish urban linkages. The poor peasant easily disconnects from land when moving to urban areas or factories to find work. On the other hand, the middle peasant rarely leaves the land himself, but he often does send his children to work in town (Wolf, 1971, p. 292). As such, the middle peasant becomes "a transmitter also of urban unrest and political ideas" (Wolf, 1971, p. 292).

Martinez-Alier (2004b, p.323) considers that the ecologism of the poor and the environmental justice movements are the main driving forces for sustainability. Polanyi notes "that a process of undirected change, the pace of which is deemed too fast, should

be slowed down, if possible, so as to safeguard the welfare of the community" (Polanyi, 2001, p.35). Additionally, he considers that liberal philosophy fails to understand the problem of change, which derives partially from the fact that it relies in reductionist economic measurements to analyse change. Therefore, incommensurability can in itself be a factor of unrest or of irresolution of ecological conflicts, due to the diversity of interests, values and even languages of valuation that cannot be placed under a single scale of measurement.

Ecological distribution conflicts can therefore be considered as a defence and emancipation of different languages and values which do not allow to be silenced by cost-benefit analysis or environmental impact assessments (Martinez-Alier, 2004b, p.323). Such opinion is shared by Homer-Dixon (1994) which notes that "mass mobilization and civil strife can produce opportunities for beneficial change in the distribution of land and wealth and in processes of governance". The road to an Ecological Economics is not "in the resolution of the environmental conflicts, but instead (within gandhian limits) in the exharcebation of conflicts" (Martinez-Alier, 2004b, p.324).

Overall, political movements connected with the idea of the environmentalism of the poor are growing. However, in many cases such conflicts over the acess to resources or environmental services do not take an explicit ecological language (Martinez-Alier, 2004a, p.318). Martinez-Alier (2004a, p.318) highlights the importance of making an historical analysis of social conflicts to understand whether there is an ecological content.

Many environmentalism of the poor groups fit into a range of labels that are inspired by agroecology and Ecological Economics: ecological neonarodnism, ecoagrarism, ecozapatism, or the Via Campesina movement Martinez-Alier (2004b, p.103). These are critics of the paradigm of increasing agrarian productivity in the orthodox way, where no environmental impacts are accounted for. They should be interpreted beyond merely politics of identity or struggles against technology or agricultural policies; instead, Martinez-Alier (2004b, p.190) considers that there is a worldwide tendency of such movements, rooted in agroecology, towards an "alternative modernity". An ecological criticism to agriculture economics is being used by a growing number of

movements worldwide (Martinez-Alier, 2004b, p.192) such as the Movimento Sem Terra in Brasil, the coalition Via Campesina, the Confederation Paysanne of José Bové or farmers movements opposing the cultivation of genetically modified organisms (GMO). Other movements exhibit a kind of ”agroecological pride“, coming from the diverse agricultural biodiversity developed by indigenous people and peasants in Latin America (Martinez-Alier, 2004b, p.191). All these movements have incorporated issues raised by environmentalist movements, from biodiversity conservation to energy saving, and transformed them into local arguments for defending peasants culture and improving life conditions (Martinez-Alier, 2004b, p.192).

Other groups of civil society, mostly composed by indigenous people and NGOs have opposed the expansion of monoculture plantations. Guha (1999, p.100) states that scientific forestry has disrupted customary rights in the peasant communities of the Himalaya, affecting their mode of social and economic organisation. In parallel with this, there were changes in the bureocracies of the state authority, needed to exert bigger control of the state over the lands. This in turned was correlated with social protest, leading the author to describe rebellion as a confrontation to the coercive actions of the state and of the forest administrations (Guha, 1999, p.100). Conflicts against monoculture tree plantations appear not only as a result of local metabolism, but also due to issues of valuation, institutional configurations that sustain power imbalances and the expansion of material flows at the global level (Gerber *et al.* , 2009). “Plantations are not Forests” is a slogan which acts as an umbrella to a wide array of organisations and movements. Many of them fit in the definition of environmentalists of the poor (Martinez-Alier, 2004b; Gerber *et al.* , 2009, p.151), dealing closely with property rights problems, access to land and availability of natural resources and services, essential for their rural lifestyle activities.

Some struggles have recently transformed into direct intervention for ecological restoration or environmental renovation. Such is the case of the Green Belt Movement in Kenya, founded by Wangari Maathai in 1977 or the Dashauli Gram Swajya Mandal. Such struggles are critic of technocentric approaches to sustainability and build from the grassroots communal management institutions (Gadgil & Guha, 1994; Berkes & Folke, 1998; Guha, 1999; Martinez-Alier, 2004b).

The issue of patents over seeds and more particularly of biotechnology in agriculture have also become an increasing cause of concern among local peasants and farmers. In the words of Martinez-Alier (2004b, p.188), “the languages of social exploitation and food sovereignity were added to the language of the defense of agricultural biodiversity against genetic erosion». Some of the lower regulatory countries are being used by the agrobiotechnology industry as a playing field for the expansion of their crop products (Martinez-Alier, 2004b, p.189). However, resistance has been evident in countries like India. The Karnataka Rajya Raitha Sangha (KRRS) launched a *satyagraha* of the seeds in the beginning of the 90s. On November 30th 1999, a global action day against capitalism linked with the first day of the WTO conference in Seattle, thousands of farmers met next to the statue of Mahatma Gandhi in Bangalore, demanding Monsanto to ”Quit India“ (like Gandhi had ordered to the English) and threatening with direct actions against their activities (Martinez-Alier, 2004b, p.188-189).

This environmentalism of the poor type of struggles are increasingly connected at the global level with struggles under completely different sets of values. The particular case of agrobiotechnology, which in the South faces resistance due to the commodification of seeds by the industry, is in the North mainly related with the ”risk society“ and the issues of expert legitimacy (Wynne, 1992; Funtowicz & Ravetz, 1993). For Simon Dalby, “technical expertise itself may lose its claim to legitimacy in irreversible ways” if it perceives environmental risks “as contingent on larger political processes and beyond technical preoccupations with localized impacts” (Dalby, 2002a, p.158). He further states that technocratic political approaches have made environmental degradation go hand in hand with political criticisms of imperialistic policies.

Another example of the increasing connectivity of the struggles between the two hemispheres, between “poor“ and ”rich“, is given by the campaigns on ecological debt. The term ecological debt has been put forward around 1990 by the Instituto de Ecología Política de Chile to denounce the result of ecological distribution conflicts occurring at an international level and over an historical time (Martinez-Alier, 2004b, p.273). It was used to counteract the idea of external debt, a major issue among countries in the global South. They result from two factors (Martinez-Alier, 2004b, p.274). Ecological debt has been increasingly used in the last decade by

movements and organisations around the world. In the North, a network of social movements, collectives and citizens created the European Network for the Recognition of Ecological Debt (http://www.enredeurope.org), which "tries to impulse and coordinate efforts in order to achieve the recognition of the Ecological Debt that European Countries have accumulated towards the impoverished countries". In the South, social movements formed the Southern Peoples Ecological Debt Creditors Alliance (SPEDCA), which denounces the ecological debt of Northern countries which started with colonization and continues to increase in the present days (see for example http://www.jubileesouth.org/journal/alliance.htm).

2.4 Insights

This section attempts to bridge some of the theoretical concepts presented along this chapter, in order to provide a link between the literature review and the empirical work. These insights create the pillars for the development of the framework and analysis in this thesis. They attempt to address some of the issues described in the Introduction, through an articulation of different parts of the Theoretical foundations. Economic reductionism is confronted with the problems of incommensurability, which in turn is strongly related to issues of complexity. Approaches to analyse the economy from a biophysical perspective have been presented, with highlight on the framework of social metabolism. Environmental security and political ecology theories have been put in contrast, in an attempt to understand their limitations and prospecting opportunities for an improved comprehension of environmental conflicts.

The main feature of distinction of environmental conflicts from other types of conflicts is that they embed the complexity from the natural systems. Therefore, while some conflicts of group identity or cultural clash can be described solely by the analysis of social complexity, in environmental conflicts the analyst must struggle with the complexity coming from both the cultural realm and the natural environment.

Environmental conflicts are often related to dynamics of industrialisation, modernisation and capitalist expansion. Said (2004, p.9) suggests that the cultural life of

the industrialised West can only be understood by considering the existence of forms of cultural supremacy. Such cultural supremacy can be understood within the concept of hegemony of Antonio Gramsci.

A process or analysis of environmental conflicts which does not explicitly address the limitation of the option space (in terms of values or languages of expression) by the hegemony, will usually fail to bring an adequate understanding of conflicts. First of all, it fails because it will not be able to perceive the larger-scale historical dynamics that have operated to structure the hegemony and its power relations. Second, an analysis or process which does not set aside from the hegemony, will render as illegitimate all identities, languages or values which fall outside its boundaries. As a consequence, it perpetuates and expands the forms of cultural supremacy, at the expense of a further marginalization of identities, languages and values contrasting with the hegemony. Third, by being post-political, the hegemony looks at conflicts as something to be avoided. This means that groups that could not push forward their values within the hegemonic structures (capitalist market, parliament, spaces of deliberative democracy, ...) and rely on conflict for their expression and defence, will be considered illegitimate actors.

Authors such as Braudel or Wallerstein point to the importance of looking at geopolitical relations to understand the development processes. However, seeing geopolitics as a simple causal relation of natural independent variables with human related dependent variables (a functionalist view) is limited in comprehending the complex nature of human-nature interactions. Norgaard (1994) has put in evidence that contemporary trends of cultural redifferentiation have been reshaping geopolitics in a distinct form than that which characterized the traditional western cultural hegemony. Moreover, consumption patterns in some regions promote increased insecurity in other regions where resource extraction takes place (as suggested by Dalby, 2002a; Barnett, 2003). Therefore, it is important to explore the resource geopolitics within an historical context and using coevolutionary approaches to socio-ecological systems, where production and consumption appear mutually interdependent.

Martinez-Alier suggests that the expression of ecological distribution conflicts, by

bringing into the debate different languages of valuation, is required to overcome the dominant paradigm of reductionist monetary valuation. Looking on the conflict as an argument or a language of valuation related to a certain identity or culture, can provide an escape out of the post-political hegemony of conflict resolution and consensus, which in certain circumstances works to perpetuate social and ecological injustices. The constraints of the hegemony can be further avoided by relying on the use of narratives and the definition of a storyteller. Perceiving the relative position of the storyteller within a geopolitical board (for example the world system) provides an important understanding of the dynamics of power related to the conflict.

The relative positions of the storyteller and the set of actors, cannot be determined by relying on some hypothetical external observation. Studying conflicts requires understanding what is relevant for the actors in the conflict, particularly for conflicting ones. In this perspective, achieving a problem structure for the analysis of ecological distribution conflicts which is useful for understanding the perception of the storyteller in relation to other narratives, constitutes perhaps one of the most challenging stages of the research. Therefore, before entering the analysis itself, the analyst should try to assess the perceptions of the set of relevant actors. Furthermore, it should look at what was at stake from the perspective of the storyteller, that has motivated them to struggle against the proposed project, policy or institution.

The use of different methodologies, often resulting in parallel information (different descriptive domains) on the same object of research (a conflict) is necessary to deal with these aspects of complexity. Methodological pluralism allows moving through the issues of incommensurability of values, providing an understanding of the different narratives and languages of the conflicts.

In summary the concept and perception of the conflict itself has to be defined by specific, parallel and non-equivalent descriptions and analysis that derive from a set of existing narratives. Acknowledging these multiple perspectives all across the conflict analysis, from the semantic, to the form, while situating them in the geopolitical historical context, provides a mechanism to avoid the limitations imposed by the hegemony. Without such an effort, it is not possible to understand the large-scale dynamics through

which the hegemony limits the values, languages and identities within the post-political space which she defines.

Ecological distribution conflicts in peripheral regions (the global South or rural areas in the North) have a stronger focus on unequal access to "resources" such as land, water or materials (such as minerals or biomass). The possibility of linking, through a quantitative biophysical approach, consumption patterns across the world with unequal exchange, can bring important policy insights to understand ecological distribution conflicts. Material flow analysis provides a quantitative approach to the social-economical system and its relation with the surrounding environment. However, while some empirical studies have related material flows or energy flows with other domains, such as land use, they are frequently falling into a physical reductionism, which does not overcome the problems of incommensurability of values. Furthermore, while these approaches often describe themselves as analysis of the social metabolism, they profoundly constrain its concept, by limiting it to the materialist dimension.

Social metabolism, originally conceptualized as an hybrid between the material and symbolic realms, should develop research that goes beyond the materialist dimension, by providing an articulation between what is material and what is constructed. The MuSIASEM approach tackles this through the use of narratives in describing and structuring of the problem. This is required to understand the cross-scale and cross-boundary connections and dynamics that induce change and disruption of social and economic systems, on certain regions or states. In the words of Dalby (2002a, p.60), "for policy reasons these interconnections are precisely where foreign and trading policies might make a contribution to changing conflict dynamics within states in the South". By equating this political concept of South to the concept of periphery in the analysis of environmental conflicts, understanding these dynamics is equally relevant in understanding conflict dynamics in territories such as those of the rural Portugal.

Agroecosystems, which comprehension is indispensable in the analysis of conflicts related to the rural, are complex systems. In order to have an adequate description of the agricultural system, the analyst must go beyond the traditional evaluations of performance based on production factors. Social metabolism, and MuSIASEM in par-

ticular, provides an appropriate framework to describe the performance and tensions of these systems. On the other hand, a farming system, similarly to other social systems, must exhibit forms of self-organisation and autocatalysis which keeps the social and ecological systems running sustainably over time. Disruptions of such cycles by external forces might bring the system into instabilities, either leading to collapse or to change (emergence).

Research on the system dynamics related to conflict might be able to trace patterns of change that have the potential to result in conflict. The social structure in place will apply feedback mechanisms to keep their pattern (culture, lifestyle) running (which, according to Boserup's argument, will be a pattern where unnecessary tasks have been excluded). In face of a potentially disruptive (of the system's reproduction) external project, an obvious feedback mechanism a community has in hand is the confrontation of such project and the emergence of a conflict situation. As such, any proper assessment of the tensions of agroecosystems (similarly to other complex adaptive systems) which might ignite feedbacks (in the form of conflicts or others), will inevitably have to include the historical context. More specifically, the historical analysis should be able to expose changes that result in pressures over the metabolic profiles of agrarian or rural systems.

Defining typologies can be useful to gain predicting power on the characteristics of changes leading to conflicts. However, they have limited usefulness on their own under a post-normal science perspective, since each individual situation makes the typology irrelevant. Furthermore, agroecosystems, being complex adaptive systems, are constantly "becoming", resulting in the impossibility to determine future states of the system. This means that the capacity of predicting whether a certain conflict will take place cannot be addressed through a definition of metabolic profiles. Such prediction can only have some relevance by looking at individual cases, where the typology knowledge is then applied.

Despite all the described difficulties in predicting conflicts, it might be possible to develop a set of abstractions which construct a meta-grammar to understand patterns related to the emergence of conflicts in a variety of contexts. Linking the MuSIASEM quantitative analysis with political ecology and environmental security theories, might

provide an understanding of which type of instabilities described in the models can become a source of conflict. In particular, political ecology and environmental security research can provide historical and political foundations (resulting from the extensive empirical research) to relate bottlenecks and forced transformations, identified by models, with the emergence of conflicts. Furthermore, as the use of quantitative analysis by experts can easily fall in the realm of the post-politics, bringing political ecology in the analysis of multiple narratives, creates an escape from reinforcing the hegemony that perpetuates social and ecological injustices, which are behind the conflicts.

Further support in achieving results that are useful beyond the specificity of the studied cases, can be given by theories on complex adaptive systems. The use of metaphors derived from this literature, might be used to abstract from patterns identified in the analysis of specific cases of conflict. The concept of holonomic constraints, which define the holonomic or rigid structure that gives rises to phenotypical traits, can be transposed to the analysis of ecological distribution conflicts. These holonomic constraints can help in describing metabolic profiles, allowing a contrast between those which characterize communities affected by projects, and those of the larger scale societies or sectors. A project or trend that is able to generate a vicious cycle (or hypercycle), can result in a fast expansion of a specific holon. The holonomic constraints of the fast expanding holon, become a non-holonomic order for the slower holon. A conflict might appear when the generated instability in the holonomic order translates into this new non-holonomic order, together with the dynamics that are part of the interrelation between communities and its environment or different levels of society (in terms of spatial scale). Adaptation to change is probably more prone to fail when the change is too fast for the social-ecological complex to cope with. Such a metaphor can be particularly useful when applied to an historical analysis of societal transformations related to capitalism or modernity.

A social metabolism approach that analyses both funds and flows and relies on the identification of holonomic and non-holonomic constraints, gives a perspective over conflicts which is not limited to matters of scarcity or abundance at a certain point in time. Quite on the contrary, it provides an integrated approach to the distribution and direction of the resources across time. This can open the possibility of simultaneously

looking at resource scarcity, resource abundance, resource value, environmental change or ecological distribution. Materials, energy, money, time or land, can be simultaneously contrasted and cross-checked for compatibility within the constraints enforced at different levels. The global market can be related to the national, the production of the national to the consumption at the global level, the national exports of primary commodities with the local community or regional requirements of land, work and money. Therefore, this application of MuSIASEM to the analysis of ecological distribution conflicts, can provide important insights on the relation between global or regional societal changes (which relate to consumption patterns), international trade, relocation of activities and impacts on local communities.

Chapter 3

Environmental history

This chapter serves two complementary purposes that will feed the analysis in the latter parts of the work. First, it collects the historical elements that provide an understanding of the ground on which the conflicts against eucalyptus plantations in the end of the 1980s in Portugal took place. It does not, however, attempt to be a full account of the historical process, but rather describe the main dynamics that influenced the particular socioecological context on which the conflicts took place. Second, it describes the eucalyptus expansion and the conflicts against this expansion. A particular emphasis is put on the narratives of those opposing the plantations, but still allowing other narratives to be collected. The reason for this is that a focus on the storyteller is considered essential for the analysis that is proposed in this work (as will be discussed in the next part).

To describe the pre-history of the conflicts, I relied on a set of literature that I found useful to bring an overall approach to the historical development of the rural world. This included documentation on the evolution of the agriculture activity and the history of scientific and industrial forestry in the country.

Finally, there is an analysis of the focus period. This includes the growth of the pulp and paper industry in the 1980s, the expansion of the eucalyptus plantations and the emergence of environmental conflicts. Most of the background information comes from the analysis of newspaper articles. I found an excellent organized repository of newspaper articles in the the Beja regional group of Quercus. As Quercus was present in

a large number of conflicts, I found this source to be good enough to start exploring case studies for the purposes of this work. Together with interviews with the former Director of the Forest Services (João Soares), now working in Portucel Soporcel, I have chosen a few conflicts, which included field visits and participatory observation. These local case studies provided a deeper understanding of the conflicting rural actors narratives and on their languages of expression. Further information on the conflicts was given by interviews to environmentalists and members of the pulp industry. The scarce literature on the issue gave punctual support to the historical analysis.

To avoid duplication, several historical elements, particularly those pertaining to stakeholder narratives and values, are only presented in the next part, during the description of the open information space.

3.1 An agrarian society

Agriculture has played a central role across the history of the Portuguese society. It was not until the second half of the 20th century that agriculture started to lose importance in the Portuguese economy. However, much of the institutions and values created by this agrarian society culture kept operating.

The offensive of liberal capitalism in the Portuguese rural society happened during the 19th century, overthrowing the “Landlord regime“ that characterized the feudalist period since the 16th century (Fonseca, 1989). Since then, the level of peasants work on agricultural production, now subject to the market logic, was very high compared with the added value generated in the new capitalist properties. The rural bourgeousie played a central role in assuring the maintenance of underpaid peasant work, by assuming a position of mediator with the economical and political agents. Liberalism did not contribute to a change in the unfavourable terms of trade of peasants, which result in an historic lack of capacity of this class to accumulate monetary resources (Hespanha, 1994).

By the time of the 2nd World War, Portugal produced almost everything it needed

internally, which allowed it to cope quite well with the world scenario. “Famine will not enter our homes” (Defesa da Beira, 8/3/1942 cit (Sá, 2001)). However, land productivity is inferior other southern European countries, under both an economic and physical point of view, which has lead to a qualitatively poor diet to the major part of the population (Hespanha, 1994)

Until the 1960s, Portuguese agriculture production systems were characterized by a large use of human time based on traditional crop techniques and low capital intensity. The balance of trade of farming products was slightly positive. Around this period, there was a relative stability of the agricultural working structures, with a large proportion of employees (60%) and an high average number of employees per boss (6) (Hespanha, 1994).

The South and the North of Portugal have also been historically distinct in what concerns property size, actors and power relations. The mountainous North of Portugal is characterized by small land properties, while the South has predominantly large land properties. This resulted in the appearance of large capitalist landowners in the South while in the Centre and North most landowners were rich peasants with whom the employees coinhabited, keeping a large cultural similarity (Hespanha, 1994).

The set of power relations have led to what Alfredo Marques (1980 cit Hespanha (1994)) describes in his doctoral thesis as an “agrarian-industrial alliance”. This alliance was a social compromise mediated by the State that would allow the creation of reasonable profit on the industrial sector at the expense of a compression of the price of agricultural inputs, up to the point that they would not interfere with the interests and privileges of the agrarian bourgeousie.

However, the increasing industrialisation pressures have forced the appearance of new policies. In the *II Plano de Fomento* (Fomentation Plan), for 1959-64, agriculture was put in a dependent role, as a supporter of industrial growth with cheap labour and food. The main developments of this plan were targeted at the creation or development of base industries such as electricity, steel, oil, fertilizers and paper pulp (Hespanha, 1994).

The recession of the Portuguese rural economy became more acute than ever before. Between 1960 and 1974, it is estimated that 10% of the total population emigrated legally or illegally. Due to the strong family and social bounds, most of the emigrants thought about a long term return to their homelands. The remaining peasant population had to adapt to the new employment structure. The adaptation was more difficult for the peasant landowners, which were deprived of cheap labor and did not hold enough capital to promote a transition in the agricultural model. Some reduced their activity to the family level, while others sold their lands. The newly available lands were quickly disputed by emigrants and peasant families which had external sources of income, leading to a boom in land prices (Hespanha, 1994).

At the same time, the overall Portuguese economy was expanding, mostly due to a fraction of the industrial bourgeoisie linked to foreign and financial capitals. This bourgeoisie progressively overtakes the power space of the agrarian bourgeoisie. Agriculture, on the other hand, by not responding to the increase in demand of food, contributed with an inflationary effect and an imbalance of the balance of trade (Hespanha, 1994).

In 1974, with the revolution against the fascist dictatorship, a socialist society project was put in place, which included widespread land reforms and even land occupations. However, by 1976, the policies were oriented toward the European capitalism model, focusing mostly on agricultural entrepreneurs and often leaving behind the care for institutional structures and policies that would benefit all the components of the agrarian population. The prices policy after 1976 further contributed to the deterioration of the real income of farmers and the production did not increase enough to supply the growing demand (Hespanha, 1994).

The proportion of farmers with off-farm activities continued to increase and by 1979 they represented 40% of the producers, bringing additional capital that supported the modernisation of agriculture (Hespanha, 1994). However, the State policies left them behind, as well as other farmers groups, such as the elderly, low educated, very small landowners or those who produce for self-consumption. According to Hespanha (1994) these groups are not only relevant from a numerical point of view, but they do as

well provide an important function of keeping the livelihood of villages and supporting the growth of other non-agricultural activities.

The entrance of Portugal in the European Economic Community (EEC) in 1986 led to major changes in the political and economical structure of the country. This meant becoming embodied in a transnational financial market and being able to access new funds, ranging from structural funds (already available before 1986) to funds coming from the productivist-oriented Common Agricultural Policy (CAP). Important changes in the rural and agricultural landscape, which include ageing and reduction of family farming populations, the abandonment of small properties, and the reduction of agricultural income have resulted from the new institutional setting. This happened side by side with political-economic changes tending to the reduction of state regulation, the reinforcement of private interest organisations and the liberalization and normalization of markets (Caleiras, 1999, p. 262).

Hespanha & Caleiras (2000) relates the entrance on the EEC to processes of deep change, derived from two simultaneous dynamics - modernisation and globalisation. These processes targeted particularly rural and agricultural spaces, the economic activiy of farmers, the life patterns of agricultural families, the social organisation in non-urban zones and the relationship between rural and urban (Hespanha & Caleiras, 2000).

The result of this change was an increase of rural conflicts, which Caleiras (1999) links to the loss of income of farmers and problems of unequal access to national and european financial instruments due to, for example, the eligibility conditions of access to funds. The EEC processes further intensified the decreasing importance of Agriculture in the growth of the Portuguese economy. Between 1980 and 2000, the contribution of the agricultural sector to GDP dropped from 7.5% to 2.0%. However, the importance of agriculture and the related social space in the Portuguese society overwhelms the economic dimension (Hespanha, 1994). Hespanha & Caleiras (2000) attributes these changes to the following dynamics:

1. changes in agricultural policies, from structural policies to market policies;

2. pressures from the logics of product standardisation;

3. changes in the type of state regulation, followed by an increased structuring of private interests and a larger institutionalisation of their representation forms (authoritarian regulation to shared regulation or even deregulation);

4. weakening of the traditional mechanisms used to bypass crisis, such as emigration, pluriactivity and state providence.

Hespanha (1994) considers that most of the current analysis on the contribution of the Portuguese agriculture to the economic growth, which point to a stagnated sector, are giving an incomplete picture. By looking at the evolution of indicators of product, employment and productivity, they miss a number of dynamic elements within the agricultural sector as well as other means with which this sector is contributing to economic growth. Lourenço *et al.* (1998) point out to different dynamics than this conventional stagnation hypothesis. They observed that land use changes in the Southern part of Portugal have intensified since the 1980s as a result of afforestation, abandonment, extensification and intensification. The loss of agricultural product in the traditional sectors, as a result of an extensification strategy, could have been compensated by the growth in other more dynamic sectors which had favourable local conditions for the intensification of the activity (Hespanha, 1994).

Several authors (Reis, 1993; Ferrão, 1997; Domingues e Marques, 1987 *cit* Hespanha (1994)) have pointed out that the availability of manpower to the Portuguese industrial sectors is highly dependent on the supply derived from the rural reproduction, that is, through the off-farm work of the farmers. Despite the strong cohesion and maintenance of traditional reproduction structures, there is an increasing consumption of industrial goods in the rural areas, mostly visible in the more urbanized villages population.

Hespanha (1994) does not consider such developments as representing a cut in the rural lifestyles, but rather a wish to improve the levels of reproduction and overcome the less interesting aspects of this lifestyle. In fact, the author observes a strong group identity among the rural population and the existence of an “excess of peasant conscience” that contrasts with the logic of the bourgeoisie classes. Family and community appear as central connecting elements and the sets of values appear quite impermeable

to urban based values, leading to a search for autonomy in what regards the integration processes of urban societies (Hespanha, 1994). This peasant conscience and its lack of assimilation by urban values appears as a characteristic of middle and high peasantry (Wolf, 1971). It is reasonable to suppose that this conscience is stronger in the Centre and North of the country, since the possession of land maintains the peasants away from a lower class condition. In the South, however, where peasants had traditionally few or no lands, abandonment and migration to urban areas was much stronger and definitive, leading to a loss of a peasant conscience. In fact, the North of the country, even inland, continues to have an higher population density than the Alentejo.

Caleiras (1999) divides the conflicts that took place in the decade following the EEC entrance in two types. Market conflicts are those which happen due to quick changes in market aspects, implying new relations in production. Defensive conflicts are related to the defence of rural populations against the abuses of political and economical power and in a search for the improvement of rural life conditions. Conflicts against eucalyptus plantations are put into this category.

3.2 The "green oil"

Luis Mira Amaral, minister of Industry, saw the eucalyptus as the "green oil of Portugal", with the potential to become one of the main sources of hard currency in the future (Gua, 1989). The pulp and paper sector is considered one of the most important industrial activities in Portugal. By 1990, 73% of the produced paper and 35% of the produced paper were being exported. de Barros (1994) points out that the value of exports of pulp and paper was the second biggest of the country, only superseeded by the textiles sector. Afonso (1994) estimated that the average gross income of eucalyptus was of 40.8 contos/hectare, a much higher figure than the estimations for pine (25 c/ha) and suber (29.7 c/ha).

The expansion of *Eucalyptus sp.* in Portugal (mostly *Eucalyptus globulus*, the only with economic relevance in the country) is closely related with the evolution of the paper pulp industry in Portugal. This tree, introduced from Australia already during the

19th century, only came to the attention of the political and economic agents on the second half of the XX century. This was related with the good fibre that this tree could produce for paper pulp in face of the new technological processes for fibre extraction. Also, eucalyptus was growing at much faster rates than the pine tress, previously the favourite raw material for paper production.

The first attempt to set up a paper factory in Portugal happened in the beginning of the 19th century, but was quickly devastated by the French Napoleonic invasions. A true paper pulp industry in Portugal only started in 1888, with the set up of the first paper mill in Caima (Radich & Alves, 2000). Until 1950, the production of paper pulp was under 10 thousand tons of paper pulp (Ferreirinha, 1989).

With a new mill in Caima (1954), the first to use sulphate bleached pulps of eucalyptus, the production went up to over 100 thousand tons by the end of the decade. The success of this technology led to the investment in new units in the following decades. The new mills in Constancia (1961), Setúbal (1967) and Figueira da Foz (1967) allowed production to grow to 400 thousand tons. By the end of the seventies, the building of new mills in Vila Velha de Ródão (1971) and Viana do Castelo (1973) pushed production to 800 thousand tons. Finally, the mill in Figueira da Foz (1984-85) pushed the production to 1.5 million thousands by 1989 (Ferreirinha, 1989; Radich & Alves, 2000).

The paper mill installed in Figueira da Foz in 1984 is of particular relevance for the analysis of the conflicts, both due to its dimension and to the point in time on which it started to operate. It has also a particularly interesting history, which I took knowledge from a personal communication of a former director of the Forestry Services. The pulp mill of Figueira da Foz was set up using equipment that had been stored for more than 10 years in different harbours in Europe. This equipment was projected for a pulp mill in Angola, but after the 1974 revolution and with the independence of the colonies, the already bought equipment lost a purpose. Only 10 years later there was a decision to create a new factory in Figueira da Foz with this equipment, marking the start of the activity of a new major company of the sector, Soporcel.

The requirements of raw materials by this industry have grown side by side with

the capacity of production. As a raw material, eucalyptus was found to be more interesting than the existing pine (*Pinus pinaster*) wood. It had the potential to grow in the non-explored semi-arid environments of the south of Portugal (Radich & Alves, 2000), whose forests were anyway becoming insufficient for the growing demand of the paper pulp industry from the 60s to the 80s.

The expansion of eucalyptus was in a first phase happening around the major factories in the area of the Cacia factory in the west coast. The appearance of a major paper mill in Setúbal opened the way for the search for new lands in the south and the eucalyptus expansion started to happen in the larger properties in the Alentejo region.

With the 1974 revolution, some of the private companies of pulp and paper were nationalised and consolidated in one group called Portucel. It was after this period and until 1990, that the area of eucalyptus had it maximum expansion. The area of eucalyptus went from around 50 000 hectares by the end of World War II to around 459 000 ha in 1990 (Leal, 1990). Of this, 66% are property of private owners and 35% are property of the paper pulp companies (Alves & Pereira, 1990).

By 1985, there was a total eucalyptus wood demand of 5.2 to 5.6 million m^3, while the potential of production was estimated in 4.5 million m^3, linked to an annual cut of 25 to 30 thousand hectares of plantations assuming an average production of 15 m^3 (Alves & Pereira, 1990). Therefore, by 1985 there was a resource scarcity of around 1 million m^3 of wood to supply the Portuguese paper pulp industry.

The Portuguese paper pulp industry is owner of forest lands, unlike most other European companies, which usually rely on contract-based agreements with the forestry sector. The choice for a model of forest ownership is probably related with the fact that this industry capital comes from foreign investors (mostly Scandinavian and English).

The paper pulp industry was offering different types of contracts to landowners. This included technical contracts; rental of lands, mostly between 24 to 26 years, with the company exploring the first two cuts and the landowner would have the right to the third cut, or with an annual rent and a share of the sales; and partnerships, where the corporation would buy the wood beforehand or would make the afforestation, while

the landowner would be obliged to sell the wood at market prices (Luis Leal, personal communication). Most of the lands that were rented were either from large farmers or from smallholders which had stopped using the lands or were planning to and, therefore had already a decreasing relation with its community.

It is difficult to say what were the previous land uses of the new eucalyptus plantations. There have been, to my knowledge, no quantitative assessments able to map former land uses with newer land uses. However, Morais (1990) attempts to relate areas with the most eucalyptus expansion and their predominant land uses. Based on this analysis, he finds that it is expectable that the eucalyptus was taking lands occupied by maritime pine (*Pinus pinaster*), uncultivated lands or marginal agriculture. This finding finds support in a personal comment from an ecologist from Quercus, which stated that eucalyptus plantations were expanding to the least productive lands, which were in a process of abandonment.

3.3 A burning country

Fires are a common characteristic of the Mediterranean climate, as a consequence of its rainy springs and its warm and dry summers. At the same time, fires have been a peasants tool to manage their land use since ancient times (Alves *et al.* , 2006), to the point that fire protection was often considered an interference in peasants customary rights (Guha, 1999, p. 51). And finally, fires have historically been considered an indicator of disorder. Whenever the landscape suffered changes in the way it was treated, particularly in periods of change - as a consequence of diseases, hunger, wars or insurrections - fires went out of control (Pyne, 2006). As such, the intensity of fires might be related with an increase in the socioecological vulnerability.

Portugal largely outstands in the impact of rural fires, even when compared with other Mediterranean countries. During the period of 1980 to 2004 there was in average a fire for each 20 ha of territory and approximately 30% of the country area was burned (Pereira *et al.* , 2006). Pereira *et al.* (2006) point out the influence of factors such as landscape homogenisation due to rural abandonment, as well as the lack of effectiveness

in fire prevention and combat. However, they also refuse to conclude that there is a tendency for an increase in forest fires, despite the increasing trend set up mainly by the large burned areas of 2003 and 2005, where severe meteorological conditions linked with these social phenomena (Pereira *et al.* , 2006).

With the low size of land property in the Portugal, particularly in the North, rural fires are spread over a large number of land owners. It is also important to note that local wood markets exhibit a dynamic of their own. Lumberjacks are usually operating on a local scale and it is within their area that they decide which wood to buy and to whom. Usually there is no capacity on the side of the lumberjacks to cut and prepare all the trees for sale, so they will choose the best offers. This leads to a race to the bottom among landowners to sell their burned wood and therefore to a fall in wood prices.

A large amount of fires occurs in non-forest lands. According to Pereira *et al.* (2006), only 32% of the burned area in Portugal (in the period of 1990 to 2005) was forest land. 56% is under the category "bushes", which also includes natural pastures and 11% of the burned area was classified in CORINE land cover charts as agricultural land (Pereira *et al.* , 2006) [1]. Due to the heterogeneity of burned areas, Pereira *et al.* (2006) prefers the use of the term rural fires, rather than forest fires.

The paper pulp companies were accused by opposers to eucalyptus plantations of being involved in arsoning in the 1980s. A first argument was that they used forest fires in order to reduce the value of land. This would enable them to buy lands for afforestation with eucalyptus at a much cheaper price. Later, another accusation related the interest of the industry in increasing the amount of available wood and, at the same time, reducing the price of wood which could no longer be used for ends other than pulp manufacturing. The companies have publicly rejected these accusations.

An expert working with the Portuguese paper industry (personal communication) argued that the companies were always buying wood at the same price and so there was no link between the forest fires and the wood availability for the industry. He did however state that the companies could not possibly know if the wood they were buying

[1] This differs from the data used here (DGRF, 2008b), where 54% of the fires in the period 1980-2003 (or 52% in 1990-2003) are classified as forest area

was burned or not. The wood would only be rejected if it had traces of burning, because this would affect the quality of the pulp. However, the lumberjacks knew this and so they could easily remove the bark and any soot traces. This means that despite publicly rejecting their influence in fires, the pulp industry could not really know to what extent they interfered with the economic motivations behind forest fires.

The paper pulp industry currently spends substantial funds to protect their private plantations. CELPA, the association of industries spends approximately 1.25 million euros per year just on helicopters (Luis Leal, personal communication). This value is not including the terrestrial means of fighting fires, which are contracted by each single company, but they provide an idea of the dimension of fires in the economy of the forestry sector.

3.4 Ecological movement and the anti-eucalyptus campaigns

Ecological movements came late to Portugal. With the exception of the Liga para a Protecção da Natureza, a conservationist association founded during the fascist regime, there were virtually no ecological movements by the time of the 1974 Revolution. Most of the criticism to the problems brought by the expansion of eucalyptus was coming from scientists or technicians, such as Manuel Gomes Guerreiro or Gonçalo Ribeiro Teles (Ter, 1989a).

Shortly after the revolution, the Movimento Ecológico Português (Portuguese Ecological Movement - MEP) was founded. The date of foundation was on the 14th of May of 1974 but the official publication of the statutes was only happening on March 5th 1975. They had a major publication - “Frente Ecológica” (Ecological Front) which came out monthly since August 1975 (Mota, 1981).

The first major ecological issue that this movement tackled was the installation of the first nuclear power plant in the country. The MEP was the main promoter of the anti-nuclear movement, which emerged with the CALCAN - Comissão de Apoio à Luta

Contra a Ameaça Nuclear - in Peniche, near Ferrel, where the Government announced the building of a nuclear power plant (Cautela, 1991). This was the first attempt at joining different ecological movements and individuals in a meeting to create a unitary movement and it resulted in the first major public ecological intervention in the country.

In 1977, Afonso Cautela, one of the founders and most influential figures of the MEP, published a book that equated the ecological struggle to a class struggle. He identified four cardinal points of destruction brought by the capitalist expansion, which he considers an allied of "technofascism". These four points comprised the industrialization process of Sines, with the refinery at its core and the Alqueva dam (a project that only took material form almost thirty years later) in the periphery; the pollution of the Alviela river, related to the industrial complex of the Lisbon periphery; the eucalyptus in the mountains of the High Alentejo which were responsible for drying fountains, wells and rivers and which he describes as a "nazi-eucalyptesque colonization" originally promoted by the fascist regime; and the pollution and wood resource waste of the Cacia pulp mill (Cautela, 1977).

The MEP had a short lifetime as a result of the very diverse ideologies of its constituting members. At the time of its creation, the movement was inspired by radical thinking coming from pacifism, anarchism, the students struggles of May 68 and the "hippies" movement (Cautela, 1991). However, it was soon joined by people not linked with the radical left, but also coming from the moderate left, from the social democrats or from Christian democrats. Such congregation of people, together with the fast developments of the newly established democracy moved the MEP into a more reformist position and started creating internal dissent among its members. By 1977, after the anti-nuclear march in Ferrel, the movement was virtually extinct. Later, in 1980, there was an attempt at reviving the MEP, but without success. By this time, other new ecological movements were emerging in the country (Mota, 1981).

In 1979, the first national ecological campaign against eucalyptus took place. The LPN conservationists were concerned about the expansion of eucalyptus plantations in the Serra da Malcata. Malcata is a mountain range in the east of Portugal, were the last known members of Iberian Lynx (*Lynx pardinus*) still exist. The campaign was clearly

conservationist in its aim: it targeted the paper pulp companies for destroying one of the most valuable assets of the country - the biodiversity and the threatened lynx. They were also contributing to a "poorer country" in this way. Figure 3.1 shows a poster was made with the title *"Salvemos o Lince e a Serra da Malcata"* (lets save the Lynx and the Malcata mountains).

This campaign was very succesful and it's slogan made it until the present day, bringing the lynx as an ex-libris of this region, but also as a symbol of nature conservation in Portugal. During the campaign, more than 46 thousand people signed in favor of the protection of this mountain area and it eventually became a nature protection site during the 80's.

Figure 3.1: LPN launched a campaign in 1979 against eucalyptus expansion in an area inhabited by the Iberian Lynx.

In November 1984, in Foz do Arelho, there was an attempt to bring together the whole environmental movement in a national campaign to defend the Portuguese Forestry. A commission was set up to prepare the work for the national ecologists gath-

ering that would take place in Tróia in March 1985. The commission was constituted by António Regedor, Jofre Justino, José Carlos Marques (activists and board members of the Portuguese Friends of the Earth - Amigos da Terra) and José Paulo Martins (activist of the project Setúbal Verde, today part of Quercus) (Ter, 1989a).

Amigos da Terra and the project Setúbal Verde ended up in dissent, leading to a failure to build a national campaign against the eucalyptus at the First National Ecologists Gathering in Tróia. This was also responsible for an internal crisis in Amigos da Terra, that would eventually lead to its collapse (Ter, 1989a).

The fact that an unitary national campaign was not developed did not stop the ecological movement to develop a growing opposition to the eucalyptus. Different regional groups linked to the Quercus journal, which was launched to public by the end of 1984 (PJ1, 1985), were already cooperating particularly in campaigns involving the eucalyptus. On October 31st 1985, they eventually converged to create a new national environmental association - Quercus. Quercus was then becoming one of the major actors in the eucalyptus debate in Portugal.

The time of this structuring and cohesion attempts also marks a point where the conflicts against eucalyptus plantations became more visible. In the words of a Quercus board member, “the conflicts started locally and we gave them more content”. It was not only content, but also public visibility at a national level, as was shown in the previous chapter analysis.

On April 5th 1986, ecologist groups organized another debate to launch a “National Campaign against Eucaliptization”. This debate was organized by Amigos da Terra, Núcleo de Acção Cultural de Valongo, Grupo Ecológico da Associação Académica de Coimbra, Grupo Quercus and the Green Party. The outcome of the debate resulted in a campaign to achieve an immediate moratorium on eucalyptus plantations. In the text, they also supported a juridical decision of a local court (in Montemor-o-Novo) that suspended an eucalyptus plantation of Portucel in lands defined as having an agricultural use. Furthermore, they joined in solidarity with local people and local authorities of Nisa, which proposed the launch of a national debate about the eucalyptus (FN1, 1986).

In the following years, the campaigns against eucalyptus and the paper pulp companies have intensified. Most of the protests, particularly the more mediatic conflicts, were led by the new and expanding association Quercus, which was not afraid of taking direct action and promoting civil disobedience together with local people.

3.5 The academic debate

To a large extent, the academic debate surrounding the eucalyptus was a remake of the debates on the afforestation policies that were implemented after the 1930s (Radich & Alves, 2000). In common, these debates present a dualism between an essentially agricultural and rural country and a country which wants to develop its forestry sector.

Mariano Feio (1914-2001) was one of the most prominent defenders of the eucalyptus within the academic world. Feio was a famous geographer with an extensive work on the geography of Portugal. After the 1950s he started to make agricultural research, by developing an experimentation setting in a 1 200 ha property in Alentejo that he inherited (see Daveau, 2002). In 1988 he wrote a book, published by the paper pulp industry (Feio, 1998), defending the importance of the eucalyptus plantations in the rural world. The book was strongly publicized in television (Catarino, 1994).

Feio (1998) considered that the decreasing economical returns of agriculture were leading to rural abandonment. The Mediterranean climate, he considers, makes it impossible to compete in terms of agricultural productivity with other countries. With the entrance in the EEC, the situation was aggravated with an open market with cheap and abundant agricultural products. The author saw the eucalyptus as a savior of the declining income of farmers which was resulting in a ”forced reconversion“ of the land use. His idea was supported by his belief that economic return is the main factor in a farmers decision. The eucalyptus was seen as particularly important in the South (Feio, 1998, p.86):

> “If towards the North there is the alternative of the maritime pine [*Pinus pinaster*] - with growth speeds that can be considered intermediate, around 30

> years until the cut - towards the South there exists no effective alternative for a wood tree and the climatic trees, cork oak and the holm oak, grow too slowly for the plantations to have an economical interest, unless they receive large non-recoverable grants"

On January 1989, a group of professors from the University of Porto subscribed a petition, stating that eucalyptus plantations were destroying natural habitats and cultural heritage in the Aboboreira mountains (DL1, 1989b). They considered that the uncontrolled expansion of eucalyptus plantations should be stopped as they will "irreversibly compromise the agro-pastoral economy of the mountain villages, leading to their desertification" (DL1, 1989b). This initiative created a point of departure from the publicized dichotomy between an emotional opposition of local people and environmentalists and the informed rational positions of experts, which legitimized governmental support to eucalyptus afforestations. However, such views constituted relatively minor islands in the academic debate.

In February 1990, the Agronomy Institute (ISA) of the Technical University of Lisbon (which was the first school having a scientific forestry course), launches a book about the environmental and socioeconomic impacts of the eucalyptus plantations in Portugal (Alves & Pereira, 1990). The book is edited by António Monteiro Alves (b. 1931), a forest economist and by João Santos Pereira (b. 1948), a forest engineer. Among the 10 authors that contributed with articles, 9 were forest scientists (mostly forest engineers) graduated in ISA. Only one of the authors was a sociologist, curiously a newly graduated (1989) working on Development Sociology and Urban Sociology. The work was funded by the paper pulp industry, science related governmental institutions and the EEC.

Despite this evident lack of interdisciplinarity and the existence of financial links with the industry, the book is often considered a good synthesis of the studies about the eucalyptus impacts in the environment and the society (for example by Radich & Alves 2000). The work appears much in line with a rational positivist or normal science, by considering the advancement of technical expertise as a solution to uninformed or passionate conflicts. The authors attempt to balance the advantages of the eucalyptus

plantations - its importance in the Portuguese economy - with the disadvantages of an unplanned mass expansion of the plantations associated with lack of technical expertise in the choice of the best locations.

A slightly more interdisciplinary debate took place in the same month. On February 15th, The Portuguese Society of Rural Studies (SPER - *Sociedade Portuguesa de Estudos Rurais*) organised a colloquium in Oeiras with the topic "*Eucalipto. Economia e Território*" (Eucalyptus. Economy and Territory). The proceedings have been published in a book four years later (SPER, 1994).

During the colloquium, Lino Fernandes, an economist, considered that, even though the eucalyptus might not have been a driver of rural abandonment, it was nevertheless a "symbol of national inability" to create minimum conditions of living to the rural populations in the areas of the plantations. The main problem pointed out by this researcher was the fact that a specialized production of eucalyptus - exported in low value products - is competing with the development of more economically interesting uses that would also allow a settlement of the population. Fernandes (1994) points out as examples rural tourism and certain industrial activities, particularly those related with forestry (carpentry, furniture, dry fruits, forest chemistry). The eucalyptus, contrarily to these activities, was not able to create employment opportunities (Fernandes, 1994).

A Biology Professor of the University of Lisbon, Fernando Catarino (Catarino, 1994), stated that industrial eucalyptus plantations have "very little or even nothing" of a forest in ecological of environmental terms. He considered that a "*rational* management of natural resources and the environment" (*emphasis* added), is needed in order to determine places where there should be forest, non-forest or intensive forestry. The last moment of the intervention is used to criticize the inclusion of a chapter in the book of Mariano Feio on the "Observation of Cases of Reconversion" [of eucalyptus plantations], a case study by Ernesto Goes, an engineer of the National Forestry Station (from the State). Catarino (1994) does however recognise the importance of the work of Feio and the need for a "*rational* development of lands" based on more efficient agroforestry uses.

Monteiro Alves and Santos Pereira were also speaking in the colloquium. Alves (1994) started by recognising the existence of multiple perspectives and visions on the topic within the society. He focus his intervention on the environmental and socioeconomic impacts of the plantations. However, since they consider eucalyptus plantations to be a productive form of land use, they reject their comparison with ”natural“ forests (Pereira, 1994).

Pereira (1994) considered that the eucalyptus plantations have a ”potential influence opposed to the degradative tendency characteristic of agriculture“ in soil fertility. Water uses, on the other hand, tend to be higher (Pereira, 1994). Alves (1994) relied on a ”solid scientific basis“ to state that the effects and interactions are variable, according to the scale and the specific location context. Pereira (1994) also defended that the socioeconomical impacts of the abovementioned water consumption could only be understood with a knowledge on the geographic aspects and local water use patterns.

The generality of the academics were suggesting that more scientific research is needed, in order to avoid a discussion without substance and where positions tend to radicalize. Feio (1998) wrote in his preface to the book a statement which describes very clearly his positivist world view:

> ”Stating without substance is not only the denial of the scientific spirit, but also the denial of rational and objective thought, the main source of progress; it is a serious vice of thought, of very harmful consequences in this, as well as in many aspects of national life. The obligation of building substance is not belonging, obviously, to all, but to the professors, the technicians and especially the ecologists that want to drive the opinion; but the people in positions with responsibility, like the mayors and others, have the obligation of appropriately selecting and valuing the information they receive.“

Alves (1994) proposed that more research was necessary to define the amount of expansion and distribution patterns of the eucalyptus over the territory. The research should bring knowledge about the following aspects on a regional basis (Alves, 1994):

1. biophysical aspects and the optimal dimensions required to safeguard the heritage,

particularly the genetic heritage;

2. dimension of areas capable of an agriculture that is competitive in the market;

3. pasturage areas, with a focus on the need to increase food production and maintain social balances;

4. productive forests areas, including eucalyptus plantations.

Even the biologist Fernando Catarino appears close to this world view. He made a distinction between two definitions of what is environment: one which is bio-ecological, where he positions himself for the analysis, and another which is political (Catarino, 1994). Despite carrying a different set of values (related to nature conservation) than Feio and showing a broader recognition of the need to include other stakeholders, he considers that top-down planning and decision-making should define the limits of such opinions (Catarino, 1994):

> ”the interests of individuals and groups have obvious limits that should be set according to the technical-scientific analysis and socioeconomical evaluation of the projects according to the models of planning and development superiorly adopted for the territory.“,

Castro Caldas appears to be the only intervener presenting a narrative that goes beyond positivism and economic reductionism. His position is particularly clear when he talks about the use the small forest property (mostly pine) as a source of credit for paying special cultural habits of the peasants such as marriages, baptisms or funerals (de Castro Caldas, 1994):

> ”The modern Technocrats don’t even have an idea of the sociological error they commit when they condemn the forest microproperty by a simple economicist preconception or business gigantism ideology“

Eugénio de Castro Caldas (1914-1999) was one of the first agricultural historians in Portugal and regent the chair on Agricultural History and Rural Sociology in

ISA[2]. de Castro Caldas (1994) made very clear statements against the afforestations, classifying the eucalyptus campaign as a ”drama“. He presented an overwhelming agricultural history of the territory since pre-Roman times, which he considered useful to provide an appropriate social context for the analysis of the eucalyptus campaign. He criticizes, first and foremost, the policy options of setting up a paper pulp industry without having supply within the territory. Integrated in the criticism are the moves ”under the shade“ of economical interests, ranging from large landowners and urban bourgeoisie to foreign investors of the international pulp industry. These interests have for example opened space for the agrarian legislators to give to the pulp industry what he calls a ”quasi-emphyteusis“ of parcels of lands that could be reunited under large properties.

3.6 Conflicts chronology (1986-90)

The growth of complexity and interdependences in the global ecological, economical and political systems puts into the media a central intermediation role among the different sectors of social life. Through the eyes of the media we can increase our capacity to look into distant realities and better understand larger time-spaces (Schmidt, 1999). This section attempts to provide a chronology of the conflicts, by looking at newspapers collections available at OBSERVA (2006) and Quercus. It also attempts to provide an overview of the motivations and values of the actors associated with each conflict.

1986

In April, the criminal court of **Montemor-o-Novo** decided to suspend the eucalyptus plantations of Portucel in **Vendas Novas**. The decision is based on eucalyptus plantations prejudice to lands with agricultural use. Ecologists from Amigos da Terra, Núcleo de Acção Cultural de Valongo, Grupo Ecológico da Associação Académica de Coimbra, «Os Verdes» Political Party and Grupo Quercus applause the decision of the court (FN1, 1986).

[2]This was the first chair in Portuguese Universities to approach rural sociology (ISA, 2006)

1987

In April, the municipality of **Castelo de Vide** puts an embargo on new eucalyptus plantations in **Serra de S. Mamede** and demands the "classification of an area of protected landscape". There is a domination of conservationist values in discourse, both of environmental groups and the local authorities. The conflict takes place between the local power and the companies which are buying land in the area. The mayor expresses support for pastoralism and olive orchards. Apart from the mayor of Castelo de Vide, Carolino Tapadeiros, other opposing actors include Quercus and José Macário, the Director of the National Parks Service, Reserves and Nature Conservation (Exp, 1987).

The municipality of **Portalegre** stops the land clearing works for the plantation of eucalyptus by Soporcel in May, after a meeting with the regional and national environmental authorities and the environmentalists from Quercus. Quercus had denounced the existence in the area of Bonelli eagles, threatened with extinction. Apart from conservational values, there are also concerns with the landscape aesthetics and the water supply to surrounding villages. The opposing actors include Quercus, Câmara Municipal de Portalegre, Directora Regional do Ambiente e Recursos Naturais do Alentejo and José Macário, the director do Serviço Nacional de Parques, Reservas e Conservação da Natureza (Rab, 1987; FN1, 1987).

1988

In May, uncontrolled eucalyptus expansion in the **Serra de Montejunto** is criticized by a local NGO working on natural and human heritage, the Associação para o Estudo e Defesa do Património Natural e Cultural da Região do Cadaval (ADDPCTV). Their criticism is targeted at the destruction of relation between the mountain range and the human being and includes an European critique ("Portugal gets everything that Europe does not want"). Desertification is pointed out as an outcome of mass eucalyptus plantations (Bad, 1988). In **Idanha-a-Nova**, Quercus and Adenex (from the Spanish state) promote a joint international campaign for the creation of the Tejo International

protected area. They consider the eucalyptus to be one of the major threats for this effort (CM1, 1988; CP1, 1988; PJ1, 1988)

In July, Portucel makes land clearing operations in an holm oak montado forest nearby the dam of **Idanha-a-Nova**. The company has paid the fine, but continued the land clearing due to the low amount of the fine (200 escudos per tree, totalling less than 100 thousand escudos). It reveals an economical related conflict between the directly involved agents (celluloses against local farmers). Property related issues are also at stake, involving eucalyptus afforestations of *baldios* and of properties with high historical or patrimonial value to the population. Amigos da Terra, GEOTA, LPN, Quercus and local farmers are among the opposing actors (DL1, 1988; DN1, 1988).

In November, a member of Quercus demands that the company Soporcel takes out the young eucalyptus (apparently planted in 1987) due to the threat they constitute to some important aquifers that supply the surrounding population in **Mosteiros**, municipality of **Arronches**. On May 13th 1987, the Municipality of **Portalegre** had stopped the works, but, despite the embargo, the plantations did not stop. Concerns invoked by the municipality of Portalegre to stop the works include landscape values, fauna and flora, as well as the threat to aquifers.

In December, the municipality of **Marco de Canaveses** puts an embargo on the Celbi intent to afforest 70 hectars of eucalyptus in the "Casa Grande" of **Manhuncelos**. Farmers state that "if the plantation moves forward, we will go there and pull out everything". They are concerned with the water consumption of the eucalyptus. Apart from this concern, the "Casa Grande" of **Manhuncelos** has an historical-cultural relevance to the local people, since 90% of its lands were belonging to the landlords. Celbi states that the local opposition to the project is resulting from external pressures, namely from Quercus. Serafim Riem, from Quercus, rejects an invitation for a lunch with Celbi engineers, stating that "Quercus accepts to discuss with the celluloses about the eucalyptus not at the table eating locust, but in front of the populations". Ferreira Torres warns of "the danger in revoking the current law", as it would remove the possibility for municipalities to embargo plantations for areas up to 350 hectares. The mayor Avelino Ferreira Torres presents himself as a "referee" for the conflict, despite having activated

an embargo (Maia, 1988; Exp, 1988).

1989

The sharp conflicts that started to take form by the end of 1988, were materializing with stronger intensity during 1989.

In January, only a few kilometres away from **Manhuncelos**, the local population of **Aboboreira** (**S. João da Folhada**) and **Entaladouro** (**Várzea da Ovelha**), mostly peasants, together with activists from Quercus, have declared "war" against Soporcel, who wants to transform mountain pasture lands in a 35 ha eucalyptus plantation. To protest, the local peasants brought 300 hundred livestock heads to the lands bought by the company in the valley, while 4 activists from Quercus blocked the works locking themselves to the machines. One caterpillar was also sabotaged at some point (DP1, 1989a; DL1, 1989c; Eur, 1989; DN1, 1989; Sec, 1989b).

The local population, living almost exclusively from pastoralism, complains that the eucalyptus will stop them from continuing to raise cattle. A local peasant, Ana Ribeiro, states that "we don't want the freedom to take over what belongs to them, we want the freedom of pasture like we had before". The mountains are used for cattle pasture by people from around 10 parishes. "It is our livestock that these lands sustain", comments one local. Yet another local complains that it is a counter-sense that the Government uses European funds to subsidize the livestock activity in the region and then allows the plantation of eucalyptus, "removing the possibility of survival of that same cattle". The ecologists of Quercus consider that "the works that are being done in the area are against many legal diplomas", one of which is related to the prohibition of eucalyptus afforestations up to 20 metres from cultivated lands (DP1, 1989a; DL1, 1989c; DN1, 1989).

The municipality of **Baião** supports the local population struggle. Furthermore, they declare to have an "inter-municipal project for the integrated development of that mountain range and the creation of the Natural Park of Aboboreira, aimed at protecting the historical and ecological heritage and at improving the life conditions of the local

populations" (PJ1, 1989a).

Quercus supports the idea that the **Serra da Aboboreira** should be considered a natural park, due to the unique ecological richness, making it the last possibility for a natural park in the district of Porto. One of the reasons is that only through this type of development in rural area becomes possible "to maintain the people in the land". The organisation considers that the works for preparing the land for eucalyptus afforestation are destroying natural vegetation areas, particularly hardwood (oaks) forests, along with rare species of birds of prey and other birds, as well as a core of megalithic monuments. As a protest, they send pieces of oak to the Prime Minister Cavaco Silva and the President Mário Soares (CP1, 1989; Sec, 1989a).

Meanwhile, the municipality of **Marco de Canaveses**, which expressed solidarity with the local people after the action, announced the legalization of the plantation one week after the protest. Soporcel was fined for starting the land clearing without previous authorization. The mayor of **Marco de Canaveses** builds up expresses its power position towards the ecologists of Quercus: "it is not Quercus that gives orders in the municipality" (DP1, 1989b).

The Environment State Secretary asks for an assessment report of the plantation and the conflict. The report concludes that the area has important values and that there are illegal procedures, but the support of the municipality of **Marco de Canaveses** to the plantation puts down any effort to create a natural park (JN1, 1989b; PJ1, 1989a; DP1, 1989b).

Two hundred professors decide to join the debate around **Aboboreira**. They express concern with the destruction of "important heritage elements (...) namely wild fauna and flora, rural architecture and arqueological heritage". It also "irreversibly compromises the agro-pastoral economy of the mountain villages, leading to their desertification" (DL1, 1989b)

In February, the municipality of **Nisa** and farmers of the village of **Tolosa** express concern about the expansion of eucalyptus plantations, promoted by a cellulose company. Four hundred people demonstrate and threaten to take "drastic positions" if the

"invasion" continues. The area of **Nisa** is characterized by small agricultural properties, which have been increasingly abandoned with the entrance in the EEC. However, at the time, there were still remaining more than five hundred farms. Among the opposing actors were the Municipality of **Nisa**, **Tolosa** farmers and other locals. The Mayor of **Nisa** approaches the Prime-Minister during his visit and requests intervention by the central administration, stating that "the eucalyptus plantation worries the farmers of Toloso". The municipality expresses concerned with the preservation of the flora, fauna, hydrological resources and soil use capacity, which is threatened by the intense and disordered expansion of eucalyptus. The eucalyptus expansion is also seen as blocking the effort to avoid desertification and rural abandonment (DL1, 1989e,f).

In the neighbouring municipality of **Portalegre**, a petition is delivered to Mário Soares, when he passed by the city during his open presidency. The petitioners claim that 800 parcels of land in the municipality were sold to the celuloses during a three month period (Gua, 1989)

In the same month, the municipality of **Portel**, also located in the **Alto Alentejo**, denounces that land clearing works for the plantation of eucalyptus in Terras Novas (Amieira) and Monte Santos (Alqueva) are being undertaken without the required legal procedures, particularly related to the licensing of the works. DGF considers that the two environmental impact assessments were "incorrect" and ordered a check up of the area, to find out that no eucalyptus had been planted until then (DL1, 1989e)

In the **North** of the country, hundreds of farmers meet in **Armada**, **Ponte de Lima**, with the aim of protesting against the parish due to its decision of renting *baldios* to Portucel for a period of 29 years. Farmers had already started to sell livestock, since they fear that there will be no pasture to raise them. Quercus expresses solidarity with the population and points out the lack of respect for the lives and people of these mountain places (Bar, 1989).

In **Valpaços** (region of Trás-os-Montes, in the inland North of Portugal), farmers of **Águas de Revés** rebel against the eucalyptus plantation (200 ha) which is replacing the olive trees in **Quinta do Ermeiro**, a property of 240 ha. The property belonged to a private owner, but the plantation was being done by Soporcel. **Valpaços** is a major

olive oil production area in the North-east of Portugal. The eucalyptus were replacing both olive trees and other fruit trees in a property with more than 5000 olive trees. On February 2nd 1989, farmers from **Água Revés** launch the alarm and uprise against the the downfall of the olives that "produce the best olive oil of the world" (CM1, 1989a).

Among the concerns is a distrust of the European integration. One of the demonstrators says that "the EEC orders to plant here what it does not want there" (DL1, 1989a). Another major concern was that the eucalyptus plantations was taking place in a private property (**Quinta do Rossio, Lugar do Ermeiro**), the largest of the area with 200 ha, which contained the most important water course of the valley. Locals were concerned that their supply of water could have been affected by such plantation. The farmers state that the eucalyptus are only worth to dry their land (CM1, 1989a).

The local populations also felt that the eucalyptus was going against the traditional production elements of the area. Olives and olive oil were the top productions, but the area also had wine, chestnuts, nuts, cherries and other fruit trees. One farmer, concerned with the future of his sons and grandsons, stated that "the eucalyptus only grows to the air and destroys the land". There was additional concern with the fact that eucalyptus might affect the water resources, since the property bought by Soporcel was crossed by most of the sources that supply the surrounding villages (Dia, 1989b).

2000 people, comprising local population of four parishes of **Valpaços**, as well as some ecologists, enrolled in a civil disobedience action. The police reaction was strong, with around 50 elements of the Intervention Brigade, as well as armed chivalry, both from the National Guard (GNR), charging over the protesters, which resulted in injuries and the arrest of one farmer. Despite this, the demonstrators, which knew previously that GNR had set up headquarters in the property, squatted the place, divided in two groups and managed to pull out three thousand eucalyptus. GNR charged again, this time with tear gas, but the demonstrators continued to pull out the eucalyptus (DL1, 1989a).

The detained farmer, José Oliveira, was only released by the end of the afternoon after negotiations of Quercus with the captain of the national guard. Some journalists were also threatened and wounded by the police intervention (DL1, 1989a). Parishes

expressed solidarity with the population fight against the eucalyptus, to the safeguard of the traditional plantations of the region.

The mayor of **Valpaços**, Francisco Tavares, tries to put a term to the conflict, by invoking the Decree-Law 357/75 from June 19th to embargo the operations of preparation, which involved cutting olive trees (CM1, 1989a). In March, the municipality of **Alfândega da Fé** invokes the same legal mechanism to embargo an eucalyptus plantation in its territory (JN1, 1989c).

The conflict in **Valpaços** became famous across the country and in the following months the opposition to new eucalyptus plantations focused in the region of **Trás-os-Montes**, with strong complementary dynamics between local powers, the farmers and the ecologists. In March, the Municipal Assembly of **Mirandela** approves a statement refusing the eucalyptus plantation. Alcides Pinto, from the Liga dos Agricultores de Mirandela (Farmers League), states that "the farmers are not against the eucalyptus as a tree, but against the takeover of lands by the cellulose multinationals". Populars in **Valongo de Milhais, Murça**, launch a petition and send it to the Environment State Secretary (DL1, 1989f; JN1, 1989c).

In June, a demonstration against the mass plantation of eucalyptus in the North-east is promoted by several farmers associations of the North of Portugal and ecological groups. It is a generalist demonstration that takes places in **Mirandela**, encompassing a mix of values that had been expressed in conflicts against eucalyptus plantations around the country. Among the participantes are farmers commissions from the **North** region, ecologists (Quercus and others) and the pastoral association of Serra da Estrela (DL1, 1989f; Gua, 1989).

The attempt to set eucalyptus plantations in **Águas Reves** was eventually dropped by Soporcel, which feared facing a growing public opposition to their attempts. Similar processes, with the industry stepping back in the plantation projects even when the legal battles had been won, occurred in other places that had a public exposure of the conflicts, such as that of **Aboboreira**.

Following the revoke of the Decree-Law 357/75 and in order to analyse the new

proposed laws for eucalyptus plantations, the Association of Agricultural, Comercial and Industrial Companies of Beira da Serra (ACIBEIRA) promotes a meeting. Farmers, forest producers, business executives, mayors and local population from **Beira da Serra** (district of **Coimbra**) organized a meeting in **Arganil** where the new legislation on eucalyptus plantations, as well as the activity of the celluloses in the area was criticized (Exp, 1989b).

Many of the municipalities of **Coimbra** are a stage for protests against the eucalyptus plantations. The mayor of **Arganil** had undertaken awareness campaigns asking the owners of lands affected by the fire of 1987 not to sell indiscriminately lands to the celluloses and to defend the traditional economical values of the region, based on forestry related companies, beekeeping and grazing livestock (Exp, 1989b). In **Dreia**, **Arganil**, locals pulled out several eucalyptus which were planted next to a water course which supplies the population. They threaten to do it again if the plantations continue. Celluloses "pillage the region", states a local. There is also concern with the threat to the water supply (Exp, 1989b)

Participating in the meeting of ACIBEIRA, the *Comissão de Melhoramentos de Anseriz* states their opposition to eucalyptus plantations, which have been replacing all the agricultural land in the area. There is a defence of agricultural values, intertwined with ecological values, in statements such as "we don't want the Australian desert in our land", or "that cannot be a good thing, since not even the birds make nests there". Hazelnut and kiwi are said to be cultivated with good results in the area (Exp, 1989b).

In December, eleven members of Quercus chained themselves to bulldozers in the Herdade dos Cachopos, **Mértola**. Working for Soporcel, the bulldozers were starting to clear the land for the afforestation of 530 hectares of eucalyptus. Other associations took part in the protest, including the Associação para a Defesa do Património de Mértola (ADPM), Partido Ecologista "Os Verdes" (Green Party), GEOTA, Agrobio and Campo Arqueológico de Mértola (Dia, 1989c; PJ1, 1989b; Mon, 1990).

Main concerns surrounded the ecological importance of the holm oak montado that was going to be destroyed by the eucalyptus plantation. The area is classified as a biotope in the Corine program. The Forests Directorate-General stated that everything

is legal, apart from some technical issues. However, based on past experiences, the environmental organisations were distrustful on the supervision of the governmental authorities, particulary regarding the enforcement of the technical safeguard measures put as a condition for allowing the plantation. The opposing organisations threaten to make a complaint against the Portuguese State in the EU, since a community law for the preservation of holm oaks was being violated (Dia, 1989c; PJ1, 1989b; Mon, 1990).

1990

In January Quercus denounces the cut of 1500 holm oaks (Quercus ilex) in a Corine biotope in Casa Franco, **Idanha-a-Nova**. DGF has supposedly authorized the cut of 800 holm oaks, but does not make comments (Fun, 1990)

In the **Azores**, Soporcel has a project to increase the area of eucalyptus from 2000 to 5000 hectares. Affected municipalities include **Lajes**, **S. Roque** and **Madalena**. The municipalities demand explanations to Soporcel and, in reply, the company offers as a compensation the funding of touristic projects of local interest. The ecologists show concern that expanding the eucalyptus plantation in the **Pico island** threatens to aggravate the already existing hydrological deficit. Furthermore, they are concerned with the preservation of endemic vegetation in the archipelago, some of which is unique in Europe (Mon, 1990).

3.7 Field research

Three conflicts - Aboboreira (January 1989), Valpaços (February 1989) and Mértola (December 1989) - were analysed in more detail through participatory research, including non-structured interviews, collection of life histories and field observation. . All these three cases had a few common characteristics: there was an evident relation with agricultural land use issues, they were ”successful“ conflict. These successes related to the stop or significant reduction of eucalyptus afforestations by the pulp industry, culminating in the resale of the lands.

I visited each of these three potential case study locations during two full days, carrying with me a draft non-directed set of questions to make to local people that I would find in the affected villages. I also went through the areas where the eucalyptus plantations were projected, trying to understand the land use patterns that were in place.

Both in the Valpaços and Mértola cases, I spoke with locals in a café of the nearby village, in an attempt to integrate with my storytellers. Cafés are in Portugal, and even more in the rural areas, a point of convergence of the population, so they are a preferential place to develop informal contacts. In both cases I inquired the café owners, as well as random people present in the café, about their memories of the conflict. I particularly attempted to have an overview of the main positions, values and arguments both of themselves and of other actors that they would mention or that I would ask about during the conversation. Other aspects which I wanted to include in my overview included: (a) the history and social network of the land properties rented or bought by the pulp industry for afforestation with eucalyptus; (b) the socioeconomic situation of the villagers; and (c) a brief profile of the agricultural activity.

In Valpaços, more specifically in Fonte Mercê, one of the villages linked to the conflict, there was a clear uneasiness from the part of the local people in describing the conflict events. The repression by the National Guard had certainly generated tensions within the local community, that left fears until the present days. Also, some people seemed to regret taking part in the conflict, stating that ”the wood could give a lot of work“ to the surrounding communities. However, the operations of afforestation that had already taken place took away thousands of olive trees (18 thousand according to a local) so, part of the socioeconomic impacts had been materialized even though the eucalyptus plantation did not proceed in the end.

In the Mértola case, I visited the café of closest village to Herdade dos Cachopos - Amendoeira da Serra. Around 200 people of this village - the majority of the population - used to work in Herdade dos Cachopos and assure their income and survival through their activity there. However, by now, very few people (around 50) live in this village and the gross majority is retired. When the company Emporsil bought the Herdade dos

Cachopos the population had already decreased substantially, to around 100 villagers.

The Herdade dos Cachopos, with approximately 1040 ha, is considered one of the best of the municipality. All the water streams run through the property in the direction of the Guadiana River. Its hills used to be filled with fig trees, around 20 ha of multifunctional olive orchards, other fruit orchards and vegetable crops.

The conflict in Mértola appeared have strong political links, possibly derived from the processes of Agrarian Reform in the post-1974. The municipality, presided by the Portuguese Communist Party, took an active stance in the conflict sueing the paper pulp company Emporsil (but lost the case). The people I interviewed stated that there was no consensus among the villagers against the afforestation. Some were in favor, as they saw employment opportunities brought the afforestation - a position that dominant among the people I contacted in the café. There were accusations that there were signatures of people in favor of the afforestation appearing in an undersigned with 200 to 300 signatures, against the plantation.

In the Aboboreira village there are no cafés. It basically is made up of a dozen houses, six villagers and around three hundred animals. My first contact, in a rainy day, was with the daughter of the main ”spokesperson“ of the peasants during the conflict, Ana Ribeiro. The daughter was coming for a visit and Ana Ribeiro was on the fields with the animals, but would come back soon. After some time she comes and invites me home to speak, offering me a bread with fried eggs and a cup of self-produced wine. Two other villagers joined and for several hours they reported their history of the conflict, with strong enthusiasm on events such as a meeting of 20 environmentalists in her house to prepare the action for the following day. They also spoke about the history of the village and the socioeconomy. But, most important might have been their worldviews, which revealed a clear conflict with the urban modernity, which they see filled with drugs, crime, pollution and stress.

In table 3.1 I present a summary of the characteristics I could observe or inquire on the field visits to these three places.

	Valpaços	Aboboreira	Mértola
Issues	thousands of olive trees were cut; surrounding villages water supply might be affected, threatening agricultural activity	loss of area for pasture threatening the living basis of the villagers; fears of water shortages	one of the best agricultural properties goes to the hands of the industry; all water streams on the area flow through the property
Landscape	Soft hills, several villages small sized agricultural land around (0.5-2 ha); some fields are uncultivated, there many recently installed intensive olive orchards	mountains with spread, isolated, small and compact villages; some forest lands, but most areas have been burned and stay uncultivated; some small agricultural fields (< 0.5 ha) around the villages	very few small and compact villages, hills, mostly forested with cork and holm oaks and eucalyptus in large properties (20-1000 ha)
Agriculture	Vines, olives, potatoes, beetroot	vegetables, corn, vines, cattle, mostly goats and sheeps (grazing)	before there were orchards, olives, vegetables, currently there is only forestry

Socioeconomy	Lack of employment opportunities, mostly journey based work, but most people temporarily emigrate to work in Spain, Andorra or Switzerland; incapacity to set prices of agricultural products (need to sell at any price to sustain); relatively aged population; women take care of the household and help in agriculture	Subsistence living of the villagers; most people migrated to urban areas, only remaining six people over 70 years old; goat cheese, sold in the city market, and goatlings, sold to people coming to the village, are the only sources of income	Herdade dos Cachopos used to employ around 200 people from the adjacent village; the village population has since then been substantially reduced; there are some projects of ecological tourism being developed, but rare working opportunities for local population can only be found in Mértola.
Culture	strong cultural identity, local popular courts (in Santa Maria	strong cultural identity, aparting from the urban modernity and even from the non-mountain rural people	some cultural identity, but appears very weakened by rural abandonment and the disappearance of the agricultural work
Conflict views	uneasiness in describing the conflict events, some regret about the stopped afforestation	pride about their role of the conflict, stability of values and ideas over time	criticism over the conflict events, accusations of manipulation and some regret that the afforestations did not proceed as planned

Table 3.1: Main characteristics of the local case studies.

3.8 The ecologism of the peasants

The conflicts against the eucalyptus have not been isolated or spread events over time and space. Quite on the contrary, they appear concentrated in time and, as will be later discussed, intertwined in values. Such characteristics reveal that the dynamics of the conflicts are not exclusively generated on the local levels where these occur. Rather, they are the result of transformations happening at larger scales, which are accompanied by the emergence of new sets of values and new languages.

One of these languages is the one of modern environmentalism, linked with the growth of the environmental movement in Portugal. Another is one which can be described as environmentalism of the poor. The interrelation between these two languages of expression is visible in several actions. In Valpaços it was particularly evident, with ecologists joining hundreds of local people in an action of civil disobedience. However, the influence of the ecologist group Quercus in defining the type of action was major. The action fits very tightly in the dynamic of the national campaign that the association was undertaking against eucalyptus and the paper pulp corporations. Furthermore, civil disobedience and direct action strategies were applied by the organisation in other contexts during that period. Activists from Quercus also had a role in connecting local conflicts, not only at the discourse level, but also by bringing people from different places together. In the case of the protest in Valpaços, they were able to bring peasants from Aboboreira.

The languages of environmentalism of the poor and modern environmentalism, while originating from substantially different social groups, appear to have a large set of common values. Such common values include the protection of natural resources and their use and management at a small/local scale, against their appropriation by large or external economic or political agents.

As these two languages appear to feed mutually on the period of time where this analysis is mostly focused - 1985-1990 - it is interesting to understand why apparently unrelated values - nature conservation VS peasants rights - merge together to form a national movement against eucalyptus which is constituted by a panoply of local

conflicts.

The local populations and smallholders, are often expressing their environmentalism indirectly. That is, they are first of all safeguarding the access to the resources, which often is results from a consuetudinary right established over time (such as is the case of the “montes livres” in the mountain areas). Such consuetudinary rights are obviously not surviving the pressures of larger scale - national and international - economic and political dynamics.

Side by side with the eucalyptus expansion, the rural abandonment of inland territories and migration of landowners to cities was taking place, leaving behind subsistence peasantry lifestyles. This further weakened the local institutions and social networks that guaranteed the maintenance and enforcement of consuetudinary rights. The market and the state - the major supra-local institutions - had an open path to take control over the management of resources in new territories.

In face of this disempowerment and seeing the threat of the eucalyptus expansion into their territories, the populations have looked for allies. The new striving environmental movement was bringing in a set of values and arguments that seemed capable of creating an obstacle to the market expansionism over these new territories. Consuetudinary rights, on the contrary, had been losing their power, not only through the processes of rural exodus, but also through the changes of values occurring in society, which have put the market and legally set property rights in a dominant position.

As such, the environmentalists of the poor started to use the language from the modern environmentalists that were opposing the eucalyptus. Over time, it becomes clear that local citizens, farmers and mayors, use more and more the language of modern environmentalist. In the conflict of Aboboreira, the municipalities of Baião and Amarante join the proposal of the environmentalists to create a nature protected site. Others, such as the Nisa municipality, make explicit in their discourse the relation between the threats to nature, desertification and rural abandonment.

But the power that environmentalism could bring into the local struggles was not only one of language and values. There were also many new laws, resulting from the

adherence of Portugal to the EEC, that created a whole new set of rights and obligations for the protection of the environment. The opposing populations and municipalities understood that and resourced frequently to laws of environmental protection to stop the continuation of eucalyptus plantations. As a consequence, the environmentalists were put in a key role, both as experts on environmental law and as a political pressure group that was capable of denouncing and exposing in the media the violations of these laws.

The exchange of values and languages was obviously not one-sided. It was frequently stated in the discourse of environmentalists and some academics that eucalyptus was increasing pressure for rural abandonment, by reducing labour opportunities and limiting the access to land and water by the local communities.

Despite this fusion of languages between the local and the national, the profile of the local actions was quite diverse. Some actions involved standing in front of the machines to block the preparation of lands for eucalyptus. This hapenned in places like Aboboreira and Mértola. In Aboboreira, the peasants took their animals in front of the machines. In Mértola the ecologists and some local people chained themselves to the machines.

In another occasion, in Valpaços, the direct action went to the point of taking off eucalyptus that were already planted. A peasant from Aboboreira (personal communication) describes the event with emotion and shows the trust that they had (and have not lost) in the ecologists that were bringing them to these struggles. This peasant stated that “they asked her if she wants to join the people of Valpaços in the protest”. The peasant went with the Quercus people, but she said that she “would not remove the eucalyptus”, because she was afraid. To her, the Valpaços people who she watched taking out the eucalyptus were “brave people”.

It might be relevant to understand the significance of this statement. The person from Aboboreira sees the act as brave, meaning its usefulness, but does not feel capable of doing the same. This implies that either there is a distinct cultural background between the protesters of Valpaços and Aboboreira or that there is a power related issue. The latter probably plays an important role, as there is an acceptance of the

importance of an action which she feels not capable of executing. It should be noted that the peasants from Aboboreira are mostly illiterate and have always been part of a peripheral, almost socially isolated territory. This is a very distinct background than that of the farmers and population of Valpaços, which are, to a larger extent, connected to the market capitalism.

Another power related issue appears in the national guard (GNR) intervention in Valpaços, which resulted in the arrest of a farmer but also in injuries to the activists and some journalists (DL1, 1989a). The detained farmer was only released by the end of the afternoon after negotiations of Quercus with the captain of the national guard (DL1, 1989a). This manifests the power that a national environmental NGO, Quercus, had in negotiating with another powerful state institution - the national guard. Is is very likely that such power was recognised by the national guard as a result of the presence of journalists. The fact that some were injured further weakened the dominant power position of the state-corporation-guard complex in the issue.

For Hespanha & Caleiras (2000), this dissatisfaction and revolt in rural areas are a demonstration of the feeling of abandonment and betrayal that the populations feel in relation to the local political power and the State policies.

Chapter 4

Institutional analysis

> "Until when the Eucalyptus Campaign? In the lack of an Agrarian Policy that defends the national interest, the Campaign will proceed in the shade, until the tropical competition arrives, explosive in the Amazon and, then, the problem will no longer be Portuguese, but of the Brazilian indigenous, if they will not be all dead."
>
> – Eugénio de Castro Caldas, 1990

An assessment of the institutional setting which was behind the conflictive expansion of the eucalyptus plantations provides an improved historical understanding of the situation. This chapter comprises three parts. The role of property in Portuguese rural society was analysed through a selected literature review; an inventory of international programmes for the Portuguese forestry was based on the analysis of other researchers; and the history of institutions and laws related to forestry was developed from literature, elements from the environmental history and the analysis of relevant laws.

4.1 The role of property

Pre-industrial societies, particularly in the Mediterranean and Iberian Peninsula exhibit strong relation between land property, wealth and power (Fonseca, 1989).

In institutional studies, property is generally seen as a bundle of entitlements and obligations. Coelho (2003) relies on a classical definition of land property of Barros (1954), which considers it as an institution setting up in which way, in which amount and under which conditions society gives men the right to take for himself the material goods and to use them or the related services, conserve them for himself or dispose them for his own profit. This definition embodies five traditional privileges regarding rural property in Portugal: the right to use, the right to transform, the right to exclude and defend, the right to the return and the right to dispose.

Hespanha (1994), on the other hand, sees property as a complex institution defined over multiple dimensions (juridical, economical, political, symbolical) which incorporate a certain social structure. This also means that one can clearly distinguish peasant property from capitalist property or traditional landlord property. Land is determinant in the economical and social reproduction of social groups related to agriculture and the rural world (Hespanha, 1994). As such, the issues and cultural constructions of property are of major relevance to understand the relation of the rural societies with their land and how this in turn influences the dynamics of land use and other social dynamics.

Historically, the majority of the rural population did not own land in Portugal. On the beginning of the 19th century, 80% of the active farming population did not possess any land property. Along the century, the emerging market bourgeoisie used part of its fortune to buy land to the landlords, which led to the conversion of land into an exploration capital and land property as a type of capitalist property . The expansion of liberal capitalism and market agriculture has also contributed to the consolidation of peasant property, explored by small tenants or feodataries. This process was, however, substantially slower than that of the agricultural-capitalist or even the new type of financial-capitalist property resulting from land speculation. The peasant population became quite vulnerable with the deprivation of the village moral economy resources to face the aggression of the new capitalist structures (Hespanha, 1994).

The *baldios*, a designation given to communal owned non-cultivated land, have been since the end of last century at the core of discussions and conflicts between

economists, agronomists, foresters and politicians (Radich & Alves, 2000) - and, of course, peasants. The use of this type of land has been strongly related to animal feeding under a pastoralist regime.

The origins of the *baldios* date back to the pre-Roman period and remain as traces of the communitary life and institutions that were characteristic of the Lusitânia regions. The Civil Code of 1867 gave for the first time a legal setting for this communal land use, classifying it as "commons" (Radich & Alves, 2000). By 1875, the *baldios* comprised more than 4 million ha Brouwer (1995). The government considered these lands either as being totally unused or at least as being used in a manner which, from its point of view, was inappropriate or undesirable. Communal ownership was equated with abandonment in terms of use and administration, notwithstanding the commons' enormous importance to local communities.

During the dictatorship, the government considered that communal ownership of the lands meant that they were unused or used and administered in an inappropriate or undesirable way (Brouwer, 1995). In 1936, the *baldios* became part of the municipality or *freguesia* property and classified as "indispensable" or "dispensable", as well as "forested or to be afforested".

This move allowed the state promoted afforestation policies to be pushed forward. "Uncultivated lands" should be subjected to afforestation in order to make the economically interesting (Radich & Alves, 2000). This led to a generalized private appropriation of the *baldios* during the first half of the 20th century (Brouwer, 1995). Conflicts between the central state and the rural populations were frequent and intense.

The private appropriation of the *baldios* was happening with an higher intensity in these mountain areas in the North and Center of the country. However, many *baldios* in the South were also privately appropriated, in the majority of the cases to increase already large properties (Radich & Alves, 2000).

Only in 1976, the new Constitution brought back the concept of the *baldios* as a "common good", with the Decree-Law 39/76 of January 16th (Radich & Alves, 2000). The Forestry Services, opposed the transfer of the management of the *baldios* to the

municipality, with fear that this would halt of reverse the afforestation as well as fragment the commons. It was in the hands of the Forestry Services to create a satisfying formulation. For this, they created a working group that would try to meet both the local demands and safeguard the forests and interests of the Forestry Services (Brouwer, 1995).

As a result, it was proposed that the commons would be kept together and restored to the village communities. However, two requisites were necessary to fulfil before returning commons to the communities. The first required that people would organize in user groups. Additionally, the state would have to recognise the commoners' assembly and management council. Another decision was to increase the gross revenues from sales of timber and other forestry products from 25 to more than 60 percent, resulting in a much better acceptance of forestry in the common lands (Brouwer, 1995).

637 management councils have been created in the follow-up of the law publication (Brouwer, 1995). However, Coelho (2003) considers that the true owners of the *baldios* have never really been integrated in the decision-making process regarding the afforestation policies. In fact, of the 637 management councils, by 1990 only 132 were still operational and only about one-third of the commons (141 000 ha) were actually administered by local communities (Brouwer, 1995).

The World Bank, through the Portuguese Forest Program (PFP), was further promoting land use changes in the communal lands in the post-1974 Revolution. Such a policy option for major afforestation was not substantially different from that followed by the dictatorship after the 1930s with the *"Plano de Povoamento Florestal"*. Table 4.2, presented in the next section, shows how the program was mostly targetting the *baldios* in the North of Portugal. The numbers bring an interesting and politically relevant contrast with the aim of the PFP. It should be recalled that the PFP was the first major programme of public intervention in private forestry in Portugal (Mendes & da Silva Dias, 2002). A relatively current estimation of the remaining *baldios* areas was made by Coelho (2002) and is presented in table 4.1.

Portuguese rural property faces a major fragmentation issue, which further hardens the peasants reproduction, since each generation has to find ways to reconstitute

Table 4.1: Area of communal lands (*baldios*) and forestry use, by region.
Source: Coelho (2002)

Region	***Baldios* area (ha)**	**% of total area**	**Forested**	**% forested**
North	261 198	12.3	233 963	89.6
Centre	207 178	8.8	184 698	89.1
Ribatejo and West	20 704	1.7	10 082	48.7
Alentejo	12 171	0.5	1 336	11.0
Algarve	6 122	1.2	2 119	34.6
Total	507 373	5.7	432 198	85.2

its property base. The progressive fractioning of property was happening after the implementation of an equal share regime by the Civil Code in 1867. Since then, emigration has become a survival option for many, while others resourced to off-farm work (Hespanha, 1994).

The equal share regime also led to a reduction of property size. In the beginning of the 20th century, the proportion of agricultural area occupied by small property was very low - 4% in the municipality of Barcelos (Basílio Teles, 1903 *cit* Hespanha (1994)). Along the 20th century, the situation has been reverted. However, the fragmentation of property that happened in the North does not mean that there is no land concentration, discontinuous lands. In fact, a reduction of land size might have facilitated land concentration (Fernando Medeiros, 1978 *cit* Hespanha (1994))

Private forested or agricultural land have very distinct characteristics across the country. Large property is dominant in the South, while very small property is prevalent in the North (figure 4.1). In the North and Centre, forest is mostly owned by small landowners which possess a large number of properties. In Ribatejo and Alentejo, forested land is mostly in the hands of large landowners who possess a few large properties (figures 4.2 and 4.3.

Rural land property continues to play a central role within the rural communities, unlike other European societies where rural abandonment and land devaluation was

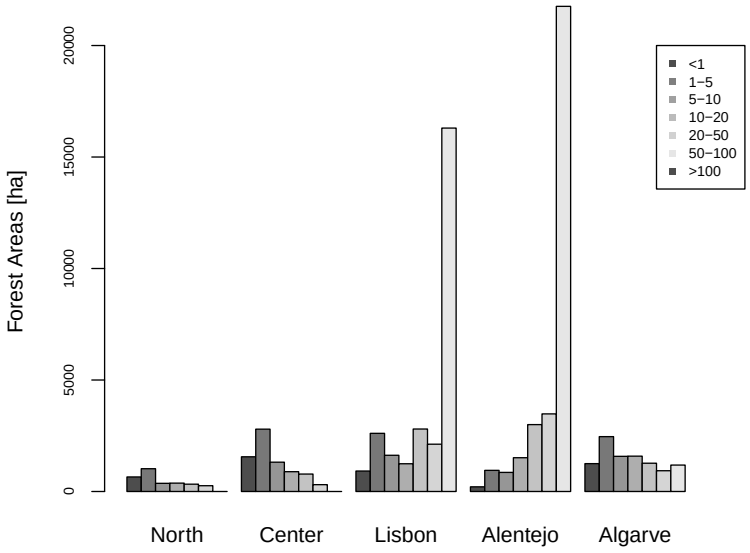

Figure 4.1: Distribution of forest property areas across property size classes. Source: Coelho (2002)

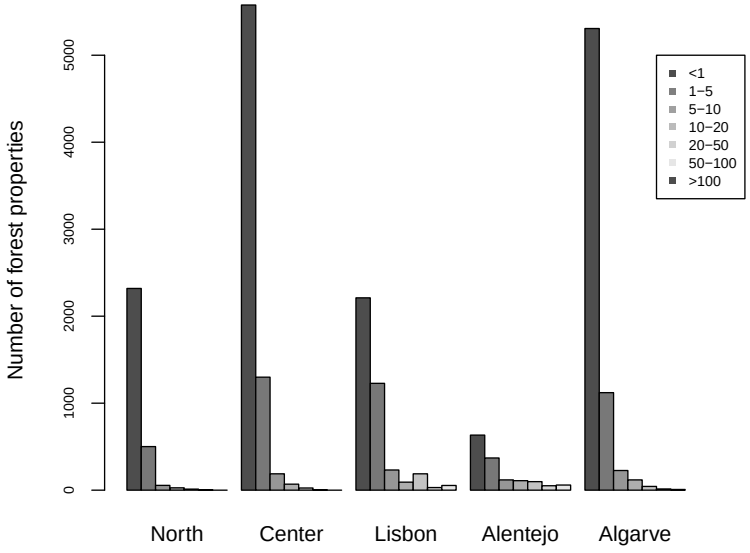

Figure 4.2: Distribution of forest property owners across property size classes. Source: Coelho (2002)

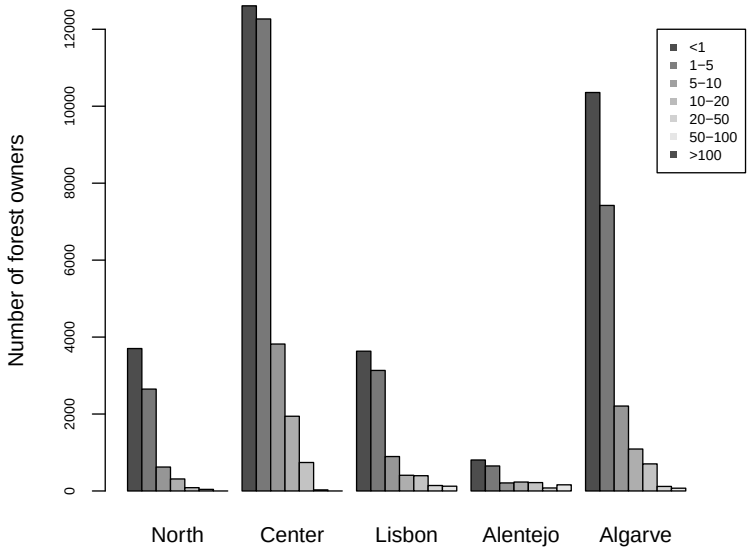

Figure 4.3: Distribution of forest properties across property size classes.
Source: Coelho (2002)

preceding the transition from a peasants agriculture to a capitalized familiar agriculture. Unlike other European countries, the land regime reforms that took place in the last centuries did not lead to the appearance of an emancipated rural burgeousie, capable of transforming the agricultural activity into a profitable market activity. On the other hand, it gave rise to a "highly mischaracterized rural bourgeousie which rather fancied the social statute of the rural aristocracy and its economical inactivity than the statute of the systematic search for profit which would be their class role" (Hespanha, 1994, p.18). The attachment to property did not seem to diminish even despite the release of the rural population from the agricultural dependency, the increased sources of income from activities external to the property or the increasing interaction with the urban society (Hespanha, 1994).

Naturally, this resulted in a reduced release of lands for activities considered to be more productive under the dimension of capital. Hespanha (1994) puts in evidence the contradiction and functionalism existing between property and capital, already explored by other authors (such as Coulomb, 1973, Massey and Catalano, 1978 and Santos, 1982). On one hand, land property appears as an obstacle to the free flow of capital to agriculture, where land is a production condition. On the other hand, land has a liberating function of the peasant manpower, pushing them to capital intensive sectors.

So, while on one hand peasant property in modern societies is slowing the expansion of agrarian capitalism, it has at the same time an essential role in allowing the expansion of other areas of the capital (Santos, 1982 *cit* Hespanha (1994)).

4.2 International programmes

4.2.1 World Bank and the Portuguese Forest Project (1981-1989)

The Portuguese Forest Project (PFP) was the first major international program directed at the Portuguese forest. The PFP was an initiative resulting from a negotiation between the Portuguese state and the International Bank for Reconstruction and Development (IBRD), a subsidiary of the World Bank (Radich & Alves, 2000).

The program had as a major objective overcoming a projected shortfall in timber supply to the export oriented pine-based and pulp and paper industries through the establishment of commercial forest plantations of conifers and eucalyptus. As a result, the PFP led to an increase of annual afforestation average supported by public intervention: from 1939 until 1965 the average was 9235 ha per year; from 1966 until 1980 the average was 12085 ha per year; with PFP the average rose to 16489 ha (Mendes, 2007b). In total, 71 905 ha were afforestated with the support of the PFP (Radich & Alves, 2000).

By the time the project was designed, the cork oak forests in the South (Alentejo) were still mostly in the hands of farm workers' co-operatives resulting from the occupations of the large farms after the 1974 Revolution. As a result of the political situation, the geographical focus of the project was the North and Center regions of Portugal (table 4.2) where there was more under-utilised potential for these species (Mendes, 2007b).

Portugal received a total 8.5 billion escudos (approximately 170 million dollars, 1980 prices) to afforestate 150 thousand ha - 90 thousand ha by the Official Services (DGF) and 60 thousand ha by Portucel between 1981 and 1987 (Radich & Alves, 2000). Mendes (2007b) has a different figure, pointing to a total of 131,908 ha of afforestation

Table 4.2: Area of afforestation funded by the PFP, by region and type of property. Source: Mendes (2002)

Region	**Communal forests**		**Private forests**		**Total**	
	ha	%	ha	%	ha	%
North	60 220	77.3	10 450	20.2	70 670	54.5
Centre	17 442	22.4	19 958	38.5	37 400	28.9
Lisbon	270	0.4	9 503	18.3	9 773	7.5
Alentejo	0	0.0	10 455	20.2	10 455	8.1
Algarve	0	0.0	1 451	2.8	1 451	1.1
Total	77 932	100.0	51 817	100.0	129 749	100.0

with numbers from DGF, divided between 71,908 ha afforestated by the Forest Services and 60 000 ha by PORTUCEL (table 4.3. Radich & Alves (2000) uses the figure of Carvalho et al (1996), which points to 80% of the area for DGF and 70% for Portucel.

Table 4.3: Targets and outcomes of the PFP. Source: Mendes (2002)

	Forest Services		**PORTUCEL**	
	target	outcome	target	outcome
Time horizon	1980-85	1981-88	1980-85	1981-88
Afforestation area (ha)	90 000	71 908	60 000	60 000
- conifers	60 500	50 026	30 500	NA
- eucalyptus	16 000	8 429	29 500	NA
- other broadleaves	13 500	7 886	-	-
- natural regeneration	-	5 586	-	-

The funding provided up to 90% (100% in burned areas) of loan on the investment cost on afforestation and infrastructures. 40% of the cuts income was used to pay the debt up to its total amount, in a maximum period of 60 years. However, the debt would be discarded in case of failure or destruction without guilt of the owner (Radich & Alves, 2000).

Carvalho et al (1996) *cit* Radich & Alves (2000) relate the lack of implementation to several factors, which include a delayed availability of the funds as well as lack of credit, problems with getting new lands and the acquisition and operation forestry machinery. Additionally, there was a weak implementation of state institutions to deal with the program.

Recently, the Portuguese government renounced to 4 million Euros of compensatory interests owed by participants on the PFP. The reasons for such are linked to a lower return on investment than expected when the contracts between the Portuguese government and the World Bank were established. This led to a situation where a maladjusted interested rate led to a growth of private debt which made landowners benefit from forest fires which would relieve them from the contractual obligations (MADRP, 2005).

4.2.2 EEC and the Forest Action Programme (1987-1995)

The Forest Action Program (PAF) was created with funding from the EEC and integrated in the Specific Program for the Development of Portuguese Agriculture (PEDAP). The program previewed an implementation period of 10 years, between 1986/87 and 1996/97 and a global investment of 57 billion escudos (ca. 381 million dollars, 1990 prices) and was executed by DGF (Radich & Alves, 2000).

The PAF was materialized in a series of laws, under the form of *Portarias* and aimed to promote a better and more intensive use of forest stands through the following types of actions:

1. afforestation of uncultivated land fit for forestry and marginal agricultural land more suitable for forestry;
2. improvement of existing stands;
3. reforestation of forest land damaged by forest fires;
4. enhancement of multiple use forestry.

The funding was consisting of non-recoverable grants on variable amounts, between 30% and 100%. Groups of landowners as well as larger areas, up to 250 hectares, would receive larger proportions of funding. 100% non-recoverable loans could be given to initiatives of public interest, such as protected areas, holm oak *montado* or *baldios*. Around 90% of the total amount was funded as non-recoverable loans (Radich & Alves, 2000).

The main stakeholders of this programme in the private sector were the non-industrial private forest owners (NIPFOs) and the forest contractors (Mendes, 2007b, p. 111).

The pulp and paper companies were almost out from the benefit of this programme, since the funding guidelines excluded fast-growth species (Radich & Alves, 2000). This is confirmed by the area of eucalyptus plantings and stand improvements that were funded by the PAF. Table 4.4 shows that the World Bank funded PFP interventions were mostly supporting the expansion of plantations that would provide raw materials for the pulp industry (pine and eucalyptus). On the other hand, the PAF was focusing more on the declining sector of cork, amounting for more than one third of the total interventions.

Table 4.4: Tree species composition of afforestations and stand improvements funded by the PFP and the PAF. Source: Mendes (2002)

Species	**PFP**		**PAF**					
			Afforestation		Improvement		Total	
	ha	%	ha	%	ha	%	ha	%
Pine	65 083	49.9	46 938	41.3	63 180	29.9	110 118	33.9
Eucalyptus	37 929	28.8	10 375	9.1	5 107	2.4	15 482	4.8
Cork oak	1 809	1.4	22 307	19.6	94 534	44.8	116 841	36.0
Others	27 087	20.5	33 941	29.9	48 233	22.9	82 174	25.3
Total	131 908	100.0	113 561	100.0	211 054	100.0	324 615	100.0

The different objectives of the programmes, led to quite different distributions of

the interventions between the different territories. The PFP focused on afforestations in the North, where significant amounts of land had been abandoned or was uncultivated (a more detailed discussion comes in the section "Property and land use"). The PAF contributed approximately one third of the funds to afforestation and stand improvements possessed by large landowners in Alentejo (table 4.5).

Table 4.5: Afforestations and stand improvements funded by the PFP and PAF, by region. Source: Mendes (2002)

Regions	**PFP**		**PAF**					
			Afforestation		Improvement		Total	
	ha	%	ha	%	ha	%	ha	%
North	70 670	54.5	40 443	35.6	28 671	13.6	69 114	21.3
Centre	37 400	28.8	29 137	25.7	33 395	15.8	62 532	19.3
Lisbon	9 773	7.5	13 137	11.6	43 823	20.8	56 960	17.6
Alentejo	10 455	8.1	13 861	12.2	88 395	41.9	102 256	31.5
Algarve	1 451	1.1	16 984	15.0	16 720	7.9	33 704	10.4
Total	129 749	100.0	113 561	100.0	211 054	100.0	324 615	100.0

The PAF had a more successful implementation that the former PFP in part, justified by Mendes (2002) by a stronger reliance of the program on the private sector, which accounts for the majority of the forest property of the country. Nevertheless, the outcome was far below the proposed targets of the program, as can be seen in table 4.6. It is particulary interesting to note the null value in the establishment of grazing areas. This denotes either (or both) a low priority in the allocation of the public subsidies to the agricultural activity or a lack of interest of private investors in developing such projects. This exposes the funders higher valuation of forestry in comparison to agriculture, at least in what regards extensive cattle raising.

Later on, reformulations of the Common Agricultural Policy have created additional funding measure to the forestry sector between 1991 and 1993 (Radich & Alves, 2000). This new formulation recognized the progressive abandonment of rural lands and crops and allowed for the afforestation of "cultures of fast growth in revolutions

Table 4.6: Targets and outcomes of the PAF. Source: Mendes (2002)

	Target	Outcome	%
Time horizon	1987-94	1987-95	-
Afforestation (ha)	400 000	113 561	28.4
Improvements (ha)	400 000	211 054	52.8
Establishment of grazing areas	100 000	0	
Forest roads	7 700	6 690	86.9
Divisional roads	3 400	2 903	85.4
Dams	400	1 053	263.2
Program cost (1000 PTE)	62 939 400	32 553 020	
- private projects	-	22 214 235	-
- public projects	-	10 338 785	-

not shorter than 16 years" (Radich & Alves, 2000, p.198).

The PAF was succeeded by a new program, the Forest Development Programme (FDP), within the Second Community Support Framework. The FDP was implemented between 1994 and 1999 with a predicted investment of 28.7 billion escudos (ca. 178 million dollars, 1994 prices) in afforestation (55 000 ha), improvement (165 000 ha), multiple use actions with non-recoverable loans between 60% and 100% and infrastructures (Radich & Alves, 2000).

The entrance in the EEC lead to a "misadjusted" process, according to Hespanha (1994, p.19). The economical reproduction of the families was decreasingly dependent on land incomes, but the consolidation of peasant property continued to happen.

Table 4.7 presents a summary of the afforested areas supported by the programs presented in this section.

Table 4.7: Afforestated areas supported by international funding between 1981 and 1999. Based on Radich & Alves (2000); own estimation for 1996-99.

	PFP	**FAP**	**EEC91**	**FDP**
1981-85	45 934	×	×	×
1986-90	25 971	58 828	×	×
1991-95	×	54 734	68 868	21 846
1996-99	×	×	×	33 154

4.3 National institutions and legislation

The State plays a relatively important role in the social processes related to the rural dynamics and land related issues in Portugal (Hespanha, 1994). The forestry policies have tipically been top down processes, with the state institution executing and controlling the application of the political measures. The reason for this centrality appears to be partly related to a weakness of the institutions directly and indirectly related to the sector (Coelho, 2003).

In 1965 there was the first attempt to separate the functions of promotion of afforestation from the management of public and common forests (Radich & Alves, 2000). This separation was partially motivated by the problems with the afforestation of the common lands (*baldios*) and also related with the differences in the management of the substantially small amount of forests owned by the state. The old *Fundo de Fomento Florestal* (FFF, meaning Forestry Promotion Fund) was given an increased importance in the management and attribution of funds, by achieving the level of a General-Directorate (Radich & Alves, 2000).

In 1977 the *Direcção-Geral de Ordenamento e Gestão Florestal* (DGOGF, meaning Directorate General for Forest Land Planning and Management) was created and the FFF, after being renamed as *Direcção-Geral de Fomento Florestal* (DGFF, meaning Directorate General for the Forestry Promotion), was again merged into the same organism,

the DGOGF (Radich & Alves, 2000).

The Decree-Law 375/75 from July 8th was one of the most important pieces of law used during the conflicts against the eucalyptus plantations of the 1980s. Built during the post-1974 revolutionary process (PREC[1]), it is a simple law aimed at the protection of natural landscapes, focused on the preservation of soils and natural cover. It consists of two articles, the first of which gives full power to the municipalities in what regards the authorization of all actions of destruction of the vegetation cover without agricultural purposes, as well as any operations of landfill or digging that result in changes to the natural landscape and arable soil layers. With the entrance in the EEC, the municipalities gained new responsibilities in terms of land use planning regulations (Mendes, 2002). This new responsibilities probably meant an expansion of municipal expertise in the area, which materialized in a frequent application of the 1975 law to embargo land clearing operations.

In 1988 the DGOGF was renamed to Direcção-Geral das Florestas (DGF, meaning Forests Directorate General). João Alves Soares took the position of General Director (Radich & Alves, 2000). The Forests General Director was invested with a significative power, being on the top of the hierarchy of the regional and local divisions.

DGF is directly tutored by the Ministry of Agriculture. This means that, effectively it is the Ministry of Agriculture that defines - or at the minimum regulates - the policies and political positions of DGF. During the conflicts of 1988 and 1989, the Minister of Agriculture had publicly expressed its will to revoke the Decree-Law 357/75 and give it a more permissive version, following the proposals of the paper pulp industry (Exp, 1989a). This was naturally opposed by the municipalities, with the Portuguese Municipalities National Association (*Associação Nacional dos Municípios Portugueses*, ANMP) sending to the Ministry of Agriculture their disagreement with a change of law that would take the embargo power away from the municipalities (Ama, 1989).

Another governmental instance, the State Secretary of Environment, was often

[1]PREC is an acronym for “Processo Revolucionário em Curso“ and relates to a process that attempted to implement a socialist society in Portugal. It ended with the events of November 25th 1975, considered by some historians as a planned counter-revolution with international linkages.

appearing in clear confrontation with the support of DGF and the Ministry of Industry to the eucalyptus plantations. However, in most cases, this confrontation of positions within the Government appeared only within conflict situations with public exposure. The blocking stance of the State Secretary of the Environment regarding the new plantations of eucalyptus was diminishing over time and eventually leading to the acceptance of the plantation. Such was the case in Aboboreira in January 1989, with the State Secretary setting up an embargo on the operations of Soporcel (relying the Decree-Law 357/75) a few hours after environmentalists and the peasants blocked the machines (Exp, 1989a). However, by the end of February, after a flip in the position of the municipality of Marco de Canaveses, CCRN (the regional body related to the State Secretary of the Environment) stated that there were no longer conditions to block the project (Rodrigues, 1989).

João Soares ended up taking the task of materializing the legal changes desired by his upper governmental instances and the pulp industry. He invested the DGF and the state with increased power upon decisions regarding fast-growth tree afforestations and operations dealing with the land cover. Decree-Law 175/88 from May 17th subjected afforestation and reafforestation operations with fast-growth species (eucalyptus, acacia and populus) over 50 ha to authorization from the DGF. On April 28th, the Decree-Law 139/89 from April 28th revoked the Decree-Law 357/75, limiting the powers of the Municipalities in what concerns afforestation projects.

With these legislative changes, the Municipalities could no longer have any say in actions for areas above 50 hectares. Under this size, their power was also reduced to a non-binding statement issued within 30 days of the project proposal. The controversial embargos that were activated by municipalities before 1989 could not be used any longer. Finally, Rule 528/89 from July 11th has set up the technical and legal conditions to eucalyptus plantations.

The new legislative package also forced large eucalyptus afforestation projects to submit environmental impact assessments. These assessments were put into public consultation for 30 days. However, an overview of the public consultation reports for these projects until 1996, has revealed a low level of participation. A few projects had

critical voices from environmental NGOs and some locals, but there is no account that they have been integrated in the decision-making process.

João Soares was replaced by Fernando Mota in 1990 (Radich & Alves, 2000). By then, conflicts became silent, in part as a probable consequence of the disempowerment of local authorities and the dominance of a scientific discourse regarding forestry and land use options. Mendes (2007b) considers that forest state institutions have been "controlled by professional foresters who knew each other well, since they all came from the single school of forestry existing in the country until the late 1970s". The people in these organisms remained over the times, many of them from the common lands afforestations of before the 70s. Together with their personal profiles, this might have led to a certain "institutional inertia". The geographic organisation itself was structured based on the management of public and communal forests (Mendes, 2007b) which might reveal that these institutions were not fit to deal with the private forest, that constituted the large part of the Portuguese forest cover.

Part II

Multiple scale integrated analysis of societal and ecosystem metabolism of conflicts

Chapter 5

Introduction

> "Nowhere has liberal philosophy failed so conspicuously as in its understanding of the problem of change"
>
> – Karl Polanyi, The Great Transformation

The importance of analysing the evolution and possible transition patterns at the national level to understand local conflicts is supported by the theoretical analysis of Polanyi (2001) and Hespanha & Caleiras (2000). Processes occurring at the national level in the Portuguese economy, particularly related to transitions from agricultural subsistence society to industrial capitalism, are able to generate dramatic pressures over the rural areas.

Such dynamics of change are not processes exclusively originated by national policies. In fact, much of the processes of modernisation and globalisation come from upper scale dynamics, as was shown in the institutional analysis. The ability to look across different levels, both geographical and sectoral, is therefore crucial to understand how macrolevel metabolic transitions can create or enhance conflicts.

This part focuses on analysing the social metabolism between 1980 and 2003, following an adapted MuSIASEM approach. The analysis itself is preceded by a pre-analytical phase where the problem is structured according to the perspectives of the actors, with emphasis on the storytellers narratives. The analysis proceeds through the different theoretical pathways (a concept which will be described later on), which

provide a bridge between theories and the case study, while providing a broad set of hypothesis for explaining the emergence of the conflicts. Finally a dialectical approach is applied to the discussion of the social metabolism dynamics, with the aim of understanding the political ecology of the conflicts against eucalyptus plantations in Portugal.

Chapter 6

Methodological notes on MuSIASEM adaptation to conflict analysis

Similarly to the MuSIASEM, the methodological approach in this work attempts to create a ”discussion support system“ that handles ”nonequivalent descriptive domains, sets of indicators referring to legitimate contrasting perspectives and nonreducible models during the process of selection of a problem structuring“ (Giampietro, 2004, p.119). As MuSIASEM is reproducing a procedural approach for soft systems methodology (SSM) proposed by Checkland (particularly following the framing of Allen and Hoekstra, which is described in detail in Appendix I: Soft Systems Methodology), it is reasonable to say that the present methodology is also epistemologically rooted in SSM.

Giampietro (2004, p.121) considers that in order to provide an adequate process to be developed from the viewpoint of the scientist, a multiple scale integrated analysis must be based on the following steps:

1. **Useful representations** of relevant features of the system able to reflect legitimate perspectives found among relevant social actors and information required for decision making of relevant agents. A first draft of a formal problem structuring (to be criticized and changed later on, as part of an iterative process) can be used to start a discussion about the semantic questions required for the problem structuring.

2. **Definition of the feasibility space** for each of the selected indicators of performance. Feasibility should reflect the reciprocal effect of constraints across hierarchical levels.

3. **Integrated representation of system performance** in relation to the selected set of incommensurable criteria. This requires selecting a package of indicators referring to the desirability of feasible changes in relation to different relevant criteria.

4. **Strategic assessment of possible scenarios**, which should be done by addressing the problem of uncertainty and general evolutionary trends that can be expected. Conventional reductionist analysis providing the picture of the position of the system on a multi-objective performance space have to be complemented by analyses of (1) evolutionary trends, (2) the crucial effects of the particular history of the system determining lock-in and behavioral constraints and (3) the parallel consideration of processes and mechanisms operating simultaneously on several levels and scales.

5. **Mosaic effects providing robustness to the scientific input, obtained through redundancy in the information space**. Mosaic effects can be obtained by bridging of non-equivalent descriptions using the forced congruence of numerical assessment across scales. The mosaic effect can be used not only to perform a congruence check on the validity of the database used in the description, but also to fill empty spaces in the database when gaps occur.

6. **Analysis of the sustainability dialectics**, which is unavoidably implied by multifunctionality and sustainability. This analysis has to include an assessment on the uncertainty associated with various scenarios considered in relation to the criteria and alternatives indicated as more relevant in the discussion.

Bringing the MuSIASEM approach in contact with conflict analysis requires some adaptations to these steps.

First and foremost, being an *ex-post* analysis, there can be no participatory process, which is normally required to legitimate the problem structure of the analyst. This

does not mean, however, that a similar procedure to the one presented by MuSIASEM and SSM cannot be applied within a decision support system. Quite on the contrary, this research can be used to improve decision making and governance on sustainability issues, as well as empower groups affected by policies, projects or development paths.

For the same reason, the iterative process between the scientist and the social actor, considered essential to compress the information space, cannot be done in practice. However, along my research, I tried my best to make a virtual iteration between my problem structuring and the perceptions of the different actors, expressed by their discourses in the media, interviews and literature.

With the purpose of emulating a participatory process, I relied on an unordered set of data from different sources in order to define the relevant characteristics for analysis. The data sources included:

1. open interviews with local actors;
2. open interviews with other actors of the conflict (paper industry and government);
3. newspaper articles;
4. literature describing the social, economic and ecological impacts of the eucalyptus around the time of the conflicts.

As an analyst, I attempted to understand and expose conflicting perspectives on the eucalyptus expansion in Portugal and the conflicts against them. Furthermore, an analyst on conflicts - which necessarily deals with major power issues - must make transparent who is he ”working for”. The idea of “client” from SSM fits well in here. However, rather than client, I prefer the term storyteller (Allen & Giampietro, 2006; Giampietro *et al.* , 2007). The term client would prefigure the existence of a superior hierarchical position of the analyst, which is not legitimate in a post-normal scientific assessment.

The main idea behind using the concept storyteller for conflict analysis is to ask for whom the system works or, rather, for whom it is not working. The analyst must

understand the (im)balances of power in order to identify the victims of proposed developments and consider these victims the storytellers. The whole problem structuring must assure that the narratives and scales are relevant and desirable by the storyteller (Giampietro *et al.* , 2007).

As the main concern of applying the MuSIASEM framework to conflict analysis is to understand the reasons behind conflicts, there is no exploration of desirable changes according to different scenarios. However, a similar dialectical exercise is used to explore the tensions created by a certain development proposal in terms of the defined indicators of performance or constraints. To enable a sustainability dialectics, the analyst can navigate through different **theoretical pathways** and confront the results of the different formalizations. By theoretical pathway, I refer to a set of knowledge acquired from the open information space by the analyst, which can be related to a set of distinct narratives on the specific situation. This concept and its application should become clear along the analysis.

These steps where constructed through an interlinking of empirical data, based on local stakeholders interviews and newspaper articles, together with the theoretical background on environmental conflicts, which was described in the previous part of this document. In the present work, theoretical pathways are sourced in the literature review on environmental security and conflicts, together with the narratives extracted from the environmental history of the conflict.

With this in mind, it is possible to move towards the exploratory analysis, aimed at understanding the main research question: why did the conflicts against eucalyptus in Portugal take place with particular intensity in the late 1980s? The patterns of change have the potential of being abstracted and used to understand other situations of environmental conflicts.

Chapter 7

Pre-analytical steps

7.1 Identifying relevant system characteristics (problem structuring)

The relevant qualities of the system under investigation must be defined before entering the analysis itself. In a process of integrated analysis and multi-criteria evaluation, such qualities should be defined, modelled and assessed in relation to a set of specified goals by the relevant social actors, for example under a participatory process. These qualities can then be used to formalize the problem structuring and develop a list of options, criteria, indicators and measurement schemes that can be used in the decision making process (Giampietro, 2004).

Acknowledging that the analysis object is a complex adaptive system, the analyst is faced with the impossibility of compressing a virtually infinite universe of discourse and values into a finite and structured information space. Any problem structuring will be missing aspects of the problem and will reflect the power struggles among the social actors. Giampietro (2004) suggests that in order to generate a fair and effective problem structuring, the compression should be done using an iterative process of problem structuring and discussion.

The iterative process of compression is described in steps 3 to 6 of the SSM

procedure (appendix III). It relies on two main compression steps. The first compression moves away from an open information space, where the goals, relevant attributes and models from stakeholders, decision makers and scientists are merged to provide a set alternatives. A second compression involves the definition of a closed information space, were the relevant alternatives can be described in terms of their consequences in order to achieve a ”satisfying“ solution for all the involved actors.

This compression might be the most crucial step of the decision-making process. Fairness, legitimacy and quality of the analysis or decisions will depend on the analyst capacity to develop a discussion support system capable of assuring a transparent flow of information between scientists, decision-makers and the remaining stakeholders or extended peer community.

7.1.1 The open information space

This first pre-analytical step requires looking as broad as possible in order to provide a rich picture of the non-equivalent perspectives from the different social actors related to the eucalyptus expansion and conflicts. Three groups structure this section: stakeholders, decision makers and scientists.

The concept of stakeholders should be self-explanatory by now. However, any stakeholders that present themselves as academics or scientists are excluded from this section. Scientists are generally seen, by contemporary technocratic Western societies, as a special group, with a relevant role in enriching the information space. By putting together the arguments, values and narratives of those who put themselves on this specific discussion space, it becomes easier to contrast them.

The decision makers are what Checkland calls the *owners* of the process. To understand who are the decision makers in the process analysed in this work, I will bring information from the chronology of the conflicts (section 3.6), as well as from the institutional setting (section 4). The last one plays a particularly important role in understanding who are the decision makers, as they are a direct consequence of the existing power structure in the system.

The information space of the scientists should normally be composed of the positions of scientists or academics which are holding a stake in the system under analysis. This statement implicitly recognises the impossibility of objective knowledge and the idea that every individual - even scientists - are no more than political economic persons guided by 'ideological orientation' (Söderbaum, 2007). The term ideology is used by Söderbaum (2007) in a broad sense, expressed as *"ideas about means and ends"* or *"means-ends philosophy"* and relating to terms such as "vision" or "*Weltanschauung*" (see appendix III).

Being an *ex-post* analysis, where part of the problem is already known, this work allows more elements to be included in the information space. More specifically, it was possible to abstract from the specific system under analysis (the conflicts against eucalyptus plantations in Portugal in the 1980s) and retrieve information from empirical studies or theoretical approaches to similar problems (environmental conflicts or conflicts over the use of resources) applied to different socioecological systems (e.g. the people and the natural resources in Rwanda).

Such an abstraction, during this phase, would not be recommended when doing ex-ante analysis, as it would "contaminate" the information space, leading to a bias in the problem structuring that would hinder the quality of the decision-making process. On the other hand, such abstractions should be made at some point in the process, to bring further knowledge to the stakeholders. However, this should not take place before the problem is properly structured and accepted by the extended peer community, as well as legitimated by the agreement of the storyteller. In *ex-post* studies, as there is no decision-making process, the researcher can safely incorporate additional elements from academic research already during the pre-analytical phase. This abstraction process is the source for generating theoretical pathways.

Stakeholders

To look at the stakeholders information space, table 7.1.1 provides a synthesis of the main arguments and policies that were described across the previous part on the history of the conflicts against eucalyptus plantations. A simple set of values was associated to

these arguments and policies. The column of the descriptive domains constitutes an element related to the of actors identities. It further includes values reflected by these artguments and policies. Together with the descriptive domains which are relevant for the actors, these consitute elements that the actors identities relate to.

Actors	Arguments or policies	Values	Domains
World Bank	*Projecto Florestal Português* (1981-87) - 50 million dollars subsidy from WB	Productivism, market-based values	Economical
EEC	Common Agricultural Policy	Agrarian productivism, market-based values	Economical
Municipalities	Corporations are buying and taking control of lands at a very fast rate	Protection of traditional values and culture	Ecological Social
	Plantations are a threat to traditional rural activities (pastoralism, agriculture, beekeeping, forestry) and go against the planned developments for the region	Landscape protection, mostly related to aesthetics, but also some conservationism	Cultural Political
	Eucalyptus plantations can affect the water supply of surrounding villages and populations	Defense of local population rights to natural resources (water, land)	
	Eucalyptus plantations conflict with landscape, fauna and flora	Defense of local power and decision-making against centralism	
	Revokation of the law that allows municipalities to embargo eucalyptus plantations is dangerous		

Actors	Arguments or policies	Values	Domains
State Secretary for the Environment (Macário Correia)	Attempts to check the legality of the situations denounced by environmentalists. Makes some temporary embargos on plantations, but most of them end up being lifted after the legal issues are solved.	Law enforcement Nature protection	Political Ecological
Minister of Agriculture (Álvaro Barreto)	Coordinates the attribution of funds of the Portuguese Forestry Project (PFP), financed by the World Bank (1981-87) Publishes the Decree-Law nr. 128/88 of April 20th Publishes the Decree-Law 139/89, from April 28th, which revokes the Decree-Law 357/75 and limits the power of municipalities in relation to forestry projects and sets up new rules.	Agrarian productivism, market-based values	Economical
Minister of Industry (Luis Mira Amaral)	Eucalyptus are the "green oil" of Portugal and a future source of hard currency	Economical development based on market values	Economical
Paper pulp industry	Local opposition to plantations projects are a result of external pressures, namely environmentalists Paper pulp industry offers good contracts to landowners	Economical development of the industry	Economical

Actors	Arguments or policies	Values	Domains
Social movements (mostly ecological, cultural and local development related)	Eucalyptus plantations destroy the relation between the human being (local populations) and its natural environment. Rural abandonment and desertification is a consequence of mass eucalyptus plantations, since only a development based on the ecological values of the place can maintain the population EEC puts in Portugal everything that is rejected by other countries. Eucalyptus are a threat to endangered species (mostly birds, such as the Bonelli eagle). Eucalyptus consume a lot of water and threaten the aquifers. Laws are either not penalizing enough the lawbreaking acts of celuloses (fines are too low, so the illegal acts are continuously perpretated) or are not enforced. General distrust on the supervision of the governmental authorities. Expanding eucalyptus plantations in mountain areas is an act of disrespect towards the lives and people of these places	Nature conservation and species protection. Local people's right to access the natural resources. Local sovereignity: local options and people are more important than national or international interests. Sustainable use of natural resources	Ecological Social Cultural Political

Actors	Arguments or policies	Values	Domains
Farmers and peasants	Eucalyptus plantations are stealing the resource base for the survival of the peasantry activities, such as pastoralism and agriculture. Common lands (baldios) are being taken by the celuloses. ”Farmers are not against the eucalyptus as a tree, but against the takeover of lands by the celulose multinationals“ Eucalyptus contribute to the destruction of soil, compromising the opportunities of future generations.	Local and national sovereignty (property and resources) Sustainable use of land and protection of natural resources	Ecological Political Economical

Actors	Arguments or policies	Values	Domains
Local population	Celuloses are taking "ownership" of common lands (baldios) and properties with high historical, cultural or patrimonial value. Celuloses are buying or renting massive amounts of local properties. Eucalyptus plantation are competing against the traditional production elements of the region. Celuloses are pillaging the region. Eucalyptus plantations threaten the water supply. EEC puts in Portugal everything that is rejected by other countries	Local and national sovereignty (property and resources) Importance of natural resources Importance of cultural heritage	Political Ecological Cultural

Table 7.1: Summary of arguments, policies and values of the actors groups of the eucalyptus related conflicts

With the summary presented in table 7.1.1, it becomes easier to move forward with the problem structuring, as the main relevant features and perspectives of the actors are now identified. This means that as many points of view for the system as possible have been generated from the actors narratives. They will later be subjected to compression, in order to extract useful representations for understanding the eucalyptus expansion in Portugal and its conflicts.

Decision-makers

The institutional analysis made in chapter 4 provides the background for understanding who are the decision-makers in the problem situation.

The decision-making processes of the afforestation policies were typically top-down, with the State playing a central role. Forest Services (**DGF**) are the core institution for the implementation of policies to promote afforestation. Furthermore, **DGF** was an hierarchical structure in geographical terms. This means that decision-making was happening at a national level rather than within the regional bodies. Another relevant aspect of the **DGF** structure was its composition, mostly by professional foresters coming from a single school and that remained in the institution since the 1970s.

With the entrance of Portugal in the **EEC**, the **municipalities** became a new major decision maker in the processes of eucalyptus afforestations, as is pretty obvious from the newspaper reviews presented in section 3.6. The **municipalities** frequently resourced to the Decree-Law 357/75 from July 8th to set up embargoes on land clearings aimed at establishing new eucalyptus plantations. Such options have been closely intertwined with the conflicts pushed forward by local people and environmentalists against the paper pulp industry.

DGF was nevertheless continuing to play a major role in the political process of the eucalyptus expansion. Afforestations with eucalyptus were only a minor part of the PAF, but **DGF** was still taking an active stance in what concerns the approval of eucalyptus plantations. Particularly, it acted as an agent of the Government in overcoming the high decision making power that was being used by the municipalities through the use of the

Decree-Law 357/75 from July 8th. In several circumstances, even in cases where the afforestation area was under 50 ha, **DGF** has publicly intervened against the position of the municipalities. Such positions denote a politically biased position of this State agent, which relied on a technocratic scientific discourse to favour the **forestry industry**.

It is difficult to say whether the political stake taken by **DGF** is a result of a direct intervention of governmental instances such as the **Ministry of Agriculture** or the *Ministry of Industry*, or rather the result of a prevalence of forest technicians strongly related with a school of industrial forestry (and therefore with the forestry and pulp industry itself).

In the first case, the larger governmental body would be at play, with strong influences from the **Ministry of Industry**, promoting the pulp and paper industry together with the eucalyptus afforestations. It must be recalled that the eucalyptus have been referred by the Minister of Industry Mira Amaral as the ”green oil“ of Portugal. If the latter aspect was dominant, then a technocratic decision making process was resulting from the influence of these forestry technicians in DGF. Probably, both aspects came into play and reinforced themselves within their sets of values. One of country development based on economic growth, the other of decision making based on expertise opinion.

Another possible decision-maker within the State institutions could be the **State Secretary of the Environment**, which appears to play a conflict mitigation role in these cases. However, it is not really acting as a decision maker in the process of the eucalyptus expansions, even though it has been an important stakeholder in some of the conflicts.

The **pulp and paper industry** might as well have played an important role in influencing the decision-making process. This role should be seen more as a lobbying stake rather than a decision-making itself. Still, contrarily, for example, to the peasants, it can be regarded as a position holding an high power of influence. The **pulp and paper industry** had a strong stance both in the economic process supported by the Ministry of Industry and in the professional proximity with the **DGF** technocrats. The institutional setting where it appears and the public positions of the State have defined this industrial sector as a core of the Portuguese economy. The professional lock-in and

the rotation of people between the forestry and pulp industry, and the state institutions, created an additional source of influence of the industry in the decision-making process.

Private landowners, including NIPFOs, represent another instance of decision-making. Operating at a different scale, they take the decisions regarding the land use of their properties. However, they can be seen as directly influenced by institutional policies which affect the perceived value that each use of land can have, as well as the value of the land itself.

Finally, as was previously mentioned, in the *baldios*, the villagers have not really been part of the decision making processes regarding afforestation. The State, through DGF, had an exclusive role in the afforestation of both public lands and *baldios*, without any existing participation mechanisms. It is common to hear among the populations how the *baldios* were ”sold out“ to private interests by their management Commissions or the local Parishes.

Figure 7.1 attempts to summarize the discussion on who are the main stakeholders which act as decision-makers within the context of the conflicts against the eucalyptus plantations.

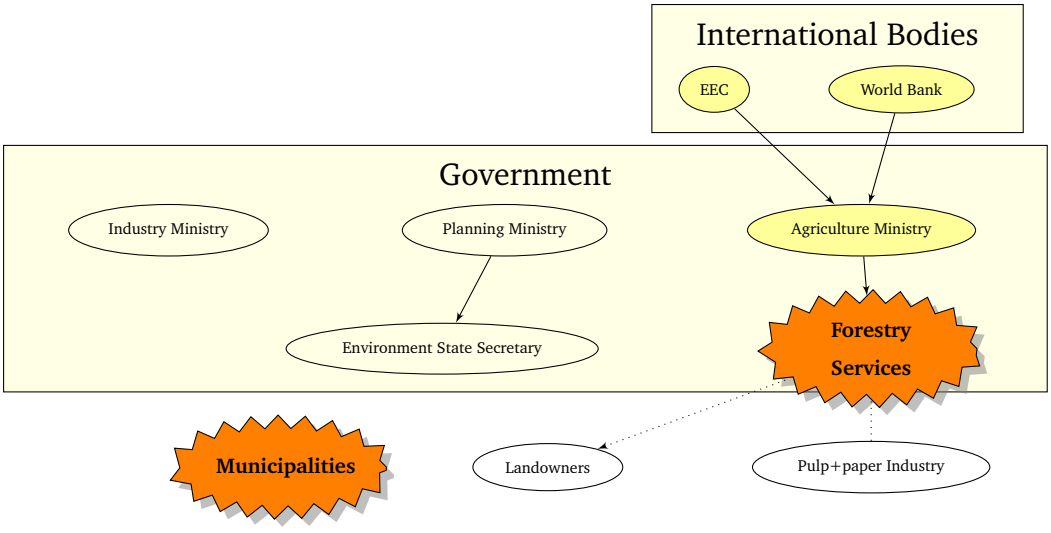

Figure 7.1: Representation of the decision makers in the context of the conflicts against the eucalyptus plantations. The colored elements are *de facto* decision makers, while the lighter represent direct influences in the process. The main conflicting decision-makers have been put in emphasis boxes.

Scientists

This section includes a synthesis of the most value charged arguments, provided by academic stakeholders in the specific case of the eucalyptus debate in Portugal in the 1980s. This debate was already described in further detail in section 3.5. Furthermore, it presents a summary of the international academic debate on environmental security and conflicts (described in detail in section 2.3), which, as was already mentioned, is a specificity of an *ex-post* analysis. To avoid repeating what was already extensively described, I present these synthesis of the Portuguese debate in table 7.2 and the more general academic perspectives on environmental conflicts on table 7.3. Both sets of arguments are grouped according to their main object.

Object	Arguments
Multi-dimensionality	There are multiple perspectives and visions on the topic of eucalyptus plantations (Alves, 1994). Eucalyptus plantations serve different functions than forests and, therefore, they should not be put in comparison (Pereira, 1994; Catarino, 1994). Technocrats fall into economical reductionism, resulting in a lack a deeper sociological understanding of the importance of other types of land uses, which are required for the maintenance of the rural cultures (de Castro Caldas, 1994).
Expert knowledge	Socioeconomical impacts of water consumption could only be understood with a knowledge on the geographic aspects and local water use patterns (Pereira, 1994). More scientific research is needed, in order to generate an informed debate and avoid a discussion without substance and where positions tend to radicalise (Feio, 1998, Alves & Pereira, 1990 and most speakers of the SPER, 1994 colloquium). Relying on the economic reductionism of modern technocrats results in the destruction of forest microproperty (de Castro Caldas, 1994).

Object	Arguments
Economical aspects	Decreasing economical returns are leading to rural abandonment (Feio, 1998). The Mediterranean climate is related to low agricultural productivities, which render this sector non-competitive (Feio, 1998). There is a need to develop more efficient agroforestry uses (Feio, 1998; Catarino, 1994). The eucalyptus can provide a solution for the declining income of farmers (Feio, 1998). Eucalyptus afforestations create minimum conditions of living to the rural populations in the areas of the plantations, due to the low value of exports (Fernandes, 1994). The use of eucalyptus to balance foreign trade is sacrificing the heritage (de Castro Caldas, 1994) "Under the shade" economic interests of large landowners, urban bourgeoisie and foreign investors has pushed legislation which facilitates the appropriation of lands by the pulp industry (de Castro Caldas, 1994).
Ecological impacts	"Rational management of natural resources and the environment" is required to determine places where there should be forest, non-forest or intensive forestry (Catarino, 1994). Eucalyptus plantations have a "potential influence opposed to the degradative tendency characteristic of agriculture" in soil fertility (Pereira, 1994). Eucalyptus afforestations "irreversibly compromise the agro-pastoral economy of the mountain villages, leading to their desertification" (several academics entering the political debate through a petition).

Table 7.2: Academic perspectives on the eucalyptus expansion in Portugal.

Object	Arguments
Resources	Population growth increases resource scarcity (Homer-Dixon, 1994). Scarcity results from a construction of complex social and environmental processes and can lead to political instability (Homer-Dixon, 1999). Elite control over productive resources (”resource capture“) linked with ”ecological marginalization“ of peasants (Homer-Dixon, 1999) Struggle to control abundant resources that have an high market values and can generate high revenues to the exploring group (de Soysa, 1999).
Environmental change	Powerful groups are at the origins of environmental degradation, either by pushing groups to living at the margins to poverty or to explore institutional and market failures (Duraiappah, 1998). Communities which lack entitlement options due to social and economic isolation and a high dependency on a natural environment, become vulnerable when the ecological system is also vulnerable (Fraser, 2003). Ecological systems are vulnerable when they have low diversity, high connectedness and are wealthy (Holling, 1986). Fires tends to go out of control in periods of socioecological change (Pyne, 2006).
Market and industrial expansion	”Environmental discrimination“ on remote areas, mountain locations and grasslands, leads to ”maldevelopment“ and is related to transitions from subsistence to market economy (Baechler, 1998). Disruptions caused by the spread of the market system perpetually threaten to turn ecosystem people into ecological refugees (Dalby, 2002a). Control approaches to security, favouring the dominant global system, result in disruptions and displacements which contribute to the development of new insecure constituencies (Dalby, 2002a). Rebellion happens as a confrontation to the coercive actions of the state and of the forest administrations to expand scientific forestry (Guha, 1999).

Object	Arguments
Ecological distribution	Increased resource consumption and its global geographic differences act as a driving force for conflicts by bringing pressure over resources (Dalby, 2002a; Barnett, 2003). Ecologically unequal exchange and environmental load displacement facilitates the consumption levels the world-system centers, by transfering the resource extraction and impacts of production to the peripheries (Hornborg, 1998; Muradian & Martinez-Alier, 2001; Martinez-Alier, 2002; Jorgenson & Rice, 2007) Ecologically unequal exchange leads to ”environmentalism of the poor“ group reactions in demand for social justice and the right to access their own natural resources, which are essential for sustaining their lives (Martinez-Alier, 2004b). Violence results from core-periphery disruptions of native people (de Soysa, 2002b; Baechler, 1998). ”Grievance“ is related to people's subjective ideas of economic justice and deprivation and constitutes a key factor in understanding civil strife (Homer-Dixon, 1999).
Group identity	What is threatened is an identity in need of being secured (Dalby, 2002a). Middle peasants have stronger urban linkages and freedom of movement and therefore have more potential of unrest (Wolf, 1971). There is a worldwide tendency of ”environmentalism of the poor“ type of movements, rooted in agroecology, towards an ”alternative modernity“ (Martinez-Alier, 2004b). Fire protection is considered an interference in peasants customary rights (Guha, 1999). Group identity conflicts are explained by group identity theories and do not fit into conflicts over resources (Homer-Dixon, 1999). Environmental conflicts are not only conflicts of interest, but also conflicts of value (Martinez-Alier, 2004b).

Object	Arguments
Technology, risk and legitimacy	Crisis of expert legitimacy (Funtowicz & Ravetz, 1993; Dalby, 2002a). Risks and threats are socially mediated political constructs (Dalby, 2002a). Technocratic political approaches have made environmental degradation go hand in hand with political criticisms of imperialistic policies (Dalby, 2002a).

Table 7.3: Scientists perspectives on environmental conflicts.

7.1.2 Preanalytical compression

The first requirement for doing this pre-analytical compression is defining who is the storyteller. I propose, for the generality of conflict analysis, that the storyteller is one which:

1. has an active role in the conflict;
2. is explicit, not constituting an hidden influence in the conflict;
3. is not a decision-maker and should have little or no influence in conventional decision-making institutions.

This set of options integrates what has been discussed in previous chapters. Of particular relevance is the idea that conflicts perpetrated under the language of the environmentalism of the poor can contribute to balance the power gaps and promote sustainability (as described by Martínez-Alier, 2004)).

Defining a storyteller allows the analyst to attempt to focus on his specific world view (*Weltanschauung*). However, this does not mean that the analyst should exclude values or descriptive domains which are not part of the world view of the storyteller.

The purpose is to have an explicitly defined bias of the analysis, in order to have both a transparent and relevant analysis for our subject matter.

As was previously mentioned, I have chosen to focus on 3 conflicts where there was an evident relation with agricultural land use issues: Aboboreira on January 1989, Valpaços on February 1989 and Mértola on December 1989. All these three cases had another characteristic in common, which was that they were "successful" conflicts, in that the pulp industry had stopped, or at least significantly reduced, their afforestation and later resold or stopped renting the non-afforested lands.

Following the proposed criteria, I selected as a broad storyteller for the analysis the local rural agricultural related people (or smallholders, in the definition of Netting, 1993)), which had conflicts against the eucalyptus plantations that have been described in the mainstream media. The Aboboreira peasants consist of a very specific identity related to smallholders, with an additional marginalization aspect related to the geography (mountain territory). As such, I considered them as a second storyteller.

This first compression step involving the definition of the storyteller, allows putting aside many conflicts where only conservation values seem to be at stake and the role of peasants or rural people is not evident.

The next compression step requires defining the relevant identities of the system. The concept of identity is defined by Giampietro (2004, p.32) as the "ability to generate and preserve in time the validity of an integrated set of viable identities (on different scales)". A proper definition of identity allows the recognition by the observer of patterns of interaction of the identity with other systems or with its environment.

Giampietro (2004, p.20) divides the definition of identities between semantic and formal:

- **semantic identity** is "the open and expandig set of potentially useful shared perceptions about the characteristics of an equivalence class";

- **formal identity** is "a closed and finite set of epistemic categories (observable qualities associated with proxies, e.g. variables) used to represent the expected

characteristics of a member belonging to an equivalence class associated with a type“.

Defining the set of semantic and formal identities requires an iterative process with a balance of normative and descriptive elements. From a defined set of semantic identities it is possible to define a relevant set of descriptive domains, based on the world view that is perceived by the analyst to be related with the identity. The descriptive domains will then provide the selection of a finite set of encoding variables, which in turn contribute to define space-time boundaries that are adequate to reveal the identities patterns within the environment.

The formal identities of the system are a normative iterative construction based on the selection of encoding variables and the space-time boundaries (holons). Holons consist of the time period and geographical scale within which each identity maintains its set of qualities, allowing a description of their specific behavior in a useful way. The definition of holons is important because time operates in dissipative systems (Prigogine & Stengers, 1984), changing the identities of the state space (Giampietro, 2004). This means that each identity should be in a steady-state situation within its holon, in order to enable the detection of its patterns of self-organization.

The construction of semantic identities is in turn influenced by the formal identities and the space-time boundaries, leading to a chicken-egg process. According to Giampietro (2004, p.119), this ”continuous shift between semantic (the use of metaphors required for the sharing of meaning about a situation - definition of classes of models) and formal models (translating the meaning of the perceptions associated with a class of models in relation to a location-specific situation to generate data related to variables that can be used as indicators) is the only way out of the impasse of reductionism“. A scheme summarizing the process of constructing the identities is presented in figure 7.2.

Both of these identities are fundamental for an integrated analysis. Semantics will help in describing the problem situation. Formalizations allow the building of models that are capable of exposing change within the holons. However, each one, on its own, is not useful in generating a useful problem structuring and therefore will not give an appropriate answer.

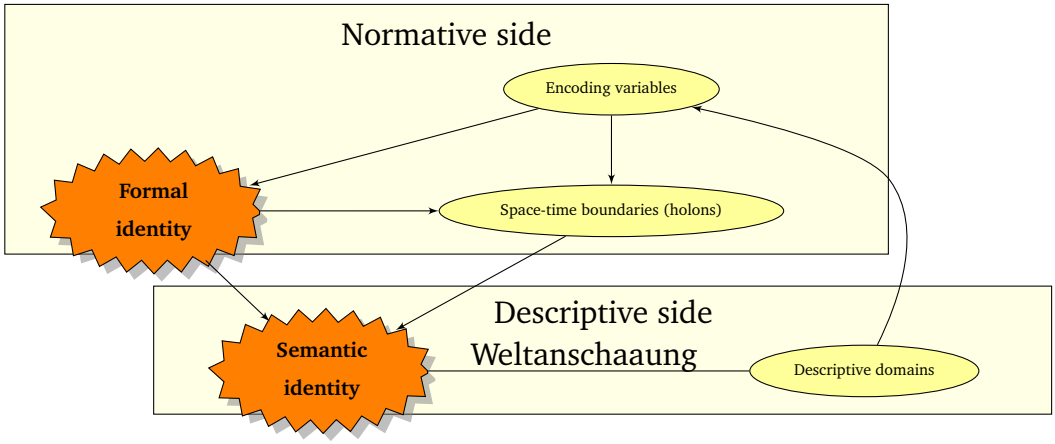

Figure 7.2: Representation of the iterative process of construction of identities.

In an *ex-ante* process, the identities, particularly their formalization process, should ideally be developed through a process involving the participation of the actors. This step would offer a validity check between the formal identities and the semantic identities, as well as with other defined identities.

In an *ex-post* analysis such as done here, I started by developing a representative set of semantic identities and associated world views, by relying on the arguments, policies and values presented in 7.1.1. Additional support comes from the scientists information space (table 7.3) and from the interpretation of the power dynamics among the actors and particularly between the storyteller and the decision-makers. Please note that any actor can be part of one or more semantic identities, as a result of their diffuse and evolving boundaries. Moreover, due to the iterative nature of defining semantic identities, part of their building blocks are only described in later sections.

Table 7.4 describes the semantic identities, their associated actors, relevant descriptive domains and space-time boundaries (holons).

Semantic identity	Features	Actors	*Weltanschauung*	Descriptive domains	Holon
Mountain peasant	Dependency on subsistence crops and relative isolation from urban areas	Aboboreira peasants	Access to land is required for survival (providing food and income)	Land use Food security Economic capital	Aboboreira mountain, 19th and 20th century
Rural	Defense of rural values and consuetudinary rights against the imposed decisions of the central state or the pulp industry	Rural inhabitants (Valpaços, Mértola, Aboboreira) Farmers Some Mayors (Mértola, Nisa, Portel, ...) Some academics (Eugénio de Castro Caldas)	Agriculture generates work and income for local people Without land for agriculture, people move away and social networks collapse City life is undesirable	Economic capital Employment level Rural population Cultural identity	Portugal, since the 19th century

Semantic identity	**Features**	**Actors**	***Weltanschauung***	**Descriptive domains**	**Holon**
Ecologist	Large interest in the preservation of cultural and/or natural heritage	Environmental and cultural social movements Secretary State of the Environment Some academics	Human activity should not go over the ecosystems limits Fertile land must be protected from inadequate uses and overexploitation Cultural and natural heritage should not be destroyed Industrial capitalists often pursue own profit by any means necessary	Freshwater resources Soil fertility Land use Cultural heritage Biodiversity Ethics	Portugal, since 1974

Semantic identity	**Features**	**Actors**	***Weltanschauung***	**Descriptive domains**	**Holon**
Economicist	Promotion of activities and projects able to generate large added value	World Bank EEC Minister of Industry Some academics	Economic growth brings benefits to individuals and society, by generating employment and improving life standards Exports benefit economic growth and development	Economic capital Employment level	Portugal, since 1981

Semantic identity	**Features**	**Actors**	***Weltanschauung***	**Descriptive domains**	**Holon**
Industrialist	Promotion of conditions to support a sustained growth of the industry, specifically the pulp and paper industry	World Bank Minister of Industry Paper pulp industry	Pulp and paper industry have a major role in the economic development of the country and in balancing the foreign trade. Pulp industry development is dependent on an increasing supply of wood, provided by fast-growing tree plantations.	Economic capital Land use Resources supply Goods production	Portugal, since 1954

Table 7.4: Map of semantic identities and descriptive domains.

7.1.3 Problem structure

After making a pre-analytical compression, a set of relevant semantic identities with descriptive domains and holons has been defined. Now, these descriptive domains should be translated to the analysis situation.

During this process of problem structuring, a set of narratives is developed. These narratives are defined by having in mind that they should be able to provide understandings on changes, in the different descriptive domains related to the defined problem situation.

By relying on the arguments and values supplied by the open information space (section 7.1.1) it is possible to develop a set of narratives for each descriptive domain. Table 7.5 puts together this information.

Descriptive domain	**Identity**	**Narrative**
Economic capital	Mountain peasant	Some income is required to buy food and goods
	Rural	Agriculture provides income for the rural population
	Economicist	Activities which contribute to the economic growth of the country,
	Industrialist	such as the pulp and paper industry, should be supported
Land use	Mountain peasant	Access to land with pastures and agricultural crops should be preserved
	Ecologist	Agricultural land should not be transformed into eucalyptus plantations
	Industrialist	The area of eucalyptus plantations must grow
Employment level	Rural	Rural employment levels must be high to maintain the population
	Economicist	Economic growth benefits employment and income

Descriptive domain	Identity	Narrative
Food security	Mountain peasant	Part of the food has to come from self-production
Rural population	Rural	A decreasing rural population leads to social problems
Cultural identity	Rural	Rural cultures should not be assimilated by the urban cultures
Freshwater resources	Ecologist	Eucalyptus plantations have significative impacts on freshwater resources
Soil fertility	Ecologist	Eucalyptus plantations contribute to the loss of soil depleting nutrients due to their intensive growth and the soil removal during afforestation operations
Ethics	Ecologist	Pulp industry is behind forest fires, which are used to get access to wood and new land for eucalyptus plantations
Resource supply	Industrialist	Portuguese forests should be able to supply the resource demand of the pulp industry
Goods production	Industrialist	The Portuguese production of pulp and paper should increase

Table 7.5: Identities and relevant narratives for the Portuguese eucalyptus conflicts analysis.

The stakeholders narratives in table 7.5 are able to describe the problem situation according to the different world views portrayed by their semantic identities. Normally, this would end the step of problem structuring.

As was previously mentioned, for the *ex-post* analysis of this research some abstractions will be made by relying on the theoretical foundations, particularly on the

elements provided by the state-of-the-art of environmental conflicts and security literature. As such, before moving forward with the formalizations, I will go through the different theories that have been summarized in table 7.3, transforming them into narratives that are relevant for the present analysis object.

This procedure makes the problem structuring and formalization pretty extensive. The reason for this lies in the impossible compression of the information space of the scientists when the aim is to use it to make abstractions to develop a coherent framework for conflict analysis. Existing abstractions must first be empirically tested before moving to another abstraction. Doing such a compression before formalizing and analysing the problem situation would mean to take an arbitrary set of theories to create these links, instead of relying on the full collection of state-of-the-art views on environmental conflicts (which will anyway be always incomplete and biased according to the background trajectories of the analyst).

Table 7.6 presents the main theories and tentative narratives which can be related to the issue of the conflicts against eucalyptus plantations. It should be noted that there was an effort to make these narratives as formalizable as possible. Those which are not formalizable, will still be relevant for a descriptive analysis of the conflict and the dialectical discussion of the results. This naturally involved an iterative process with the formalization procedures described in the next section. For clearer cross-referencing, the last column of table 7.6 provides a link to the theoretical pathway (a concept which will be described in the next section), by numbering the formalized narratives. The theories have been structured in an order that attempts to provide a coherent sequence of the analysis.

Theory	**Narrative**	**F**
Population growth increases resource scarcity	Land available for extraction of biomass is insufficient as a result of population growth	0
Scarcity results from a construction of complex social and environmental processes and can lead to political instability	Changes in the metabolic profiles lead to scarcity of land providing food security or generating an acceptable income	1

Theory	Narrative	F
Elite control over productive resources (”resource capture“) linked with ”ecological marginalization“ of peasants	Land for agriculture is taken away for industrial forestry	2
Struggle to control abundant resources that have an high market values and can generate high revenues to the exploring group	Increasing value of pulpwood leads to a race to appropriate lands for eucalyptus afforestation	3
Powerful groups are at the origins of environmental degradation, either by pushing groups to living at the margins to poverty or to explore institutional and market failures	Industrialists and Economicists push eucalyptus plantations into lands used by marginal groups, through market power or arsoning	A
Communities which lack entitlement options due to social and economic isolation and a high dependency on a natural environment, become vulnerable when the ecological system is also vulnerable	Communities conflicting against the eucalyptus plantations have an high dependency on a natural environment, which becomes vulnerable with the plantations and lack of alternatives to provide income and/or food	4
Middle peasants have stronger urban linkages and freedom of movement and therefore have more potential of unrest	Increasing income in agriculture leads to the appearance of middle peasants, which are more able to develop conflicts against unwanted eucalyptus plantations	5
Fires tend to go out of control during periods of socioecological change	As part of a larger socioeconomic transition, the pulp industry expansion and its resulting land use changes, appears related with the increasing number of fires in the country.	6
Increased resource consumption and its global geographic differences act as a driving force for conflicts by bringing pressure over resources	World paper consumption and its difference across regions increase the need and use of land for eucalyptus plantations and result in an environmental load displacement	7

Theory	Narrative	F
Ecologically unequal exchange and environmental load displacement facilitates consumption levels at the world-system centers. Ecologically unequal exchange leads to ”environmentalism of the poor“ group reactions in demand for social justice and the right to access their own natural resources, which are essential for sustaining their lives	Declining terms of trade of wood, pulp and paper and/or the decline of incomes from work in agriculture are related to the emergence of an ”environmentalism of the poor“ type of discourse against eucalyptus plantations. Behind this ecologically unequal exchange promotes is a growing world consumption of paper	8
”Environmental discrimination“ on remote areas, mountain locations and grasslands leads to ”maldevelopment“ and is related to transitions from subsistence to market economy	Changes in the metabolic profile of the country pushed the communities metabolic profile into a transition	A
”Grievance“ is related to people’s subjective ideas of economic justice and deprivation and constitutes a key factor in understanding civil strife	Conflicting communities feel that eucalyptus plantations are economically unjust and deprive them from their lands	A
Disruptions caused by the spread of the market system perpetually threaten to turn ecosystem people into ecological refugees	Economic growth and/or growth of the pulp and paper production is related with the decrease of rural population in the country	9
What is threatened is an identity in need of being secured	The expansion of industrial forestry accelerates the pace of the system and threatens the survival of rural identities	A
Control approaches to security, favouring the dominant global system, result in disruptions and displacements which contribute to the development of new insecure constituencies. Rebellion happens as a confrontation to the coercive actions of the state and of the forest administrations to expand scientific forestry	Institutional changes and policies have favored market capitalism, economic growth and industrial forestry, leading to disruptions on the metabolic profiles of the communities. Opposition to such policies have suffered state repression	A

Theory	Narrative	F
There is a worldwide tendency of ”environmentalism of the poor“ type of movements, rooted in agroecology, towards an ”alternative modernity“	Conflicting communities share values with ecologists, which promote, for example, sustainable agriculture in detriment of industrialism (including forestry and agriculture related)	A
Group identity conflicts are explained by group identity theories and do not fit into conflicts over resources	Scarcity results from the construction complex social and environmental processes but is unrelated to identity. Therefore, the social metabolism framework is not useful in understanding group identity conflicts	A
There is a crisis of expert legitimacy.	Actors opposing the eucalyptus plantations do not accept the arguments of the forest experts	A
Technocratic political approaches have made environmental degradation go hand in hand with political criticisms of imperialistic policies	Technocratic decision-making of the government and the Forestry Services contributes to the expansion of eucalyptus plantation over richer ecosystems, resulting in criticisms of environmental degradation, of democratic centralism (government and/or EEC) and of favoring the paper pulp multinationals	A
Risks and threats are socially mediated political constructs.	It is the perception of the risk and threats of proposed projects, rather than their real impact, which motivates political action	A

Table 7.6: Narratives related to the state-of-the-art of literature on environmental conflicts and security. The F column gives an indication whether the narratives will be formalized or only used as auxiliaries for the discussions (A).

In terms of time, most conflicts occur within the period of the PAF and post-EEC entrance. As such, defining the holons to comprise this time period, can provide an overview of the pressures and changes exerted over the identities. These pressures and changes should become visible with a useful formalization of the identities, which is developed in the next section.

By now, the analyst should have in hands a relevant problem structuring of his analysis subject. This means that it is time to temporary move away from the descriptive side, jumping away from the complexity of the real world, into the simplicity of models.

7.2 Building the models

This section proceeds begins the formalization process of the problem structure. As previously mentioned, formalizations should be developed in a way that expose relevant changes occurring in the defined holons, through an analysis of modelled metaphors of the real world.

After having identified the narratives, it is important to understand which system dynamics might be of interest to look at. This requires the use of parallel descriptive domains since the different narratives are intertwined within the social ecological metabolic approach. Figure 7.3 provides a map of the system dynamics according to a set of possible causal relations between the conflict narratives.

Land, agriculture and eucalyptus plantations are put in evidence since they are main issues for the storytellers. The conflict expresses itself in an opposition to the installation of eucalyptus plantations in land that should otherwise be used for agriculture. This is obvious in this *ex-post* analysis. In an ex-ante analysis, it is probably not desirable to set such a focus, as this would limit the capacity to understand potential points of change that could result in conflict.

From figure 7.3, a further compression can be applied, by excluding cycles which will not be subject to analysis. There are two reasons for this exclusion. One is related with a lack of time or data for the analysis. The other has to due with the relative

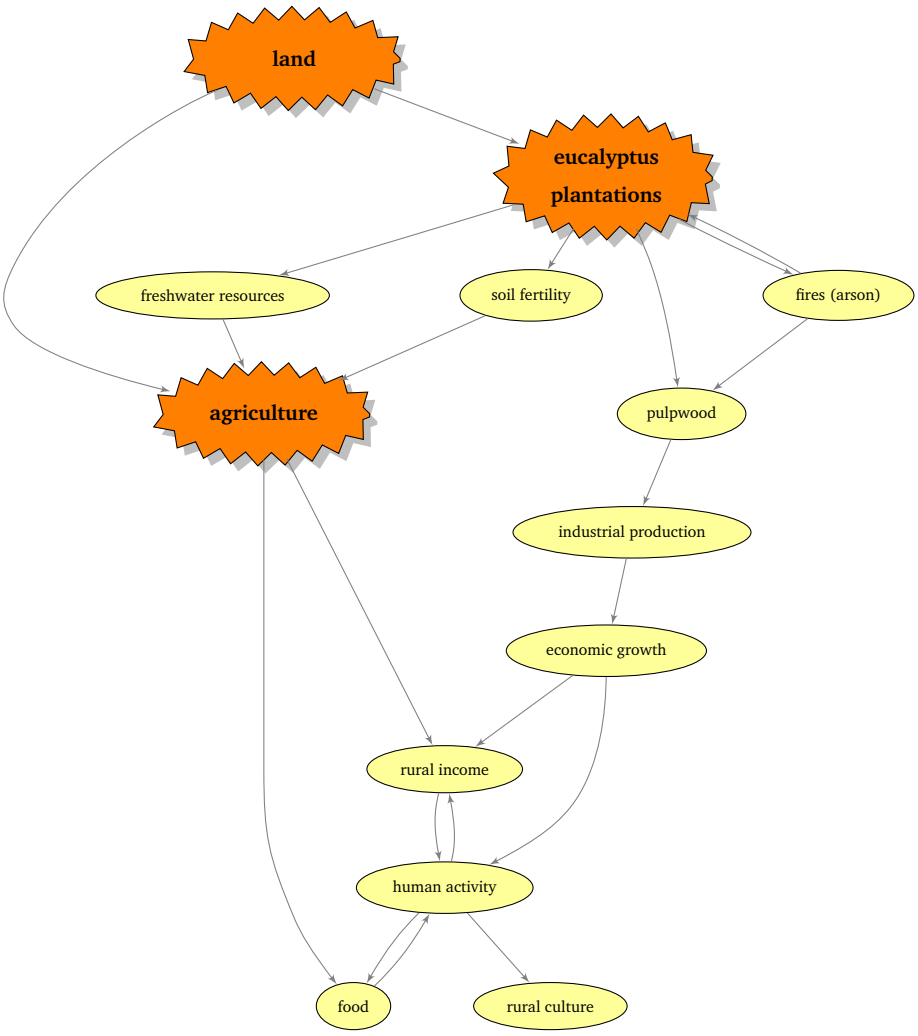

Figure 7.3: Map of the system dynamics of the eucalyptus plantations issue, according to the actors narratives.

importance of the dynamic in the understanding of the analysis subject, from the world view of the storyteller.

It is important to note that relevance is independent from whether it is "correct" according to some expert knowledge. What matters for a group to engage in a conflict (or simply in the definition of an opinion) is its perception over a certain issue. Naturally, this would be different for an ongoing process. Time is becoming and, as such, the decision making of the stakeholders can also be positively influenced by relevant information. The outcome of the proposed analysis, could certainly provide input in such an ongoing process.

Turning back to the present analysis, the issues of depletion of freshwater re-

sources and loss of soil fertility will be ignored. Despite being major arguments used against eucalyptus plantations, they are not rooted in the storytellers experience at the time of the conflicts. During all interviews, these arguments appeared as imported from the ecological movement and a fringe of academics. Actually, peasants and farmers, seem to present this issue as a mere auxiliary in the land use conflict between fast-growth forestry and agriculture. This makes it not essential in the analysis of the ”big picture“. Last but not least, this decision is also related lack of data and theoretical background, within the existing time constraints.

To proceed further with the compression, I included the enlarged information space of the scientific literature, summarized in table 7.3. In order to merge the narratives from the two information spaces - actors and scientists - I developed theoretical pathways. On the system dynamics map of the actors narratives, I link the literature narratives from table 7.6, which provide non-reducible parallel paths of explanation. This will develop a mosaic over the cause-effect relationships.

Theoretical pathways are able to provide an additional consolidation of the models. These intertwined explanation paths can be cross-checked for integrity. On the other hand, they bring simplicity. By projecting spotlights on what may be the key aspects or relations of the problem situation, it is easier to make an additional compression by putting aside the least relevant theoretical narratives. The result is shown in figure 7.4.

Figure 7.4 brings a much more interesting understanding of the adaptive cycles that are at play in the problem situation. The theoretical pathways have been placed with the particular aim of exposing system dynamics that potentially generate hypercycles. Understanding whether these holons are reproduced in a steady state, or if they move away from equilibrium, is fundamental to trace the causes and dynamics leading to the emergence of conflicts.

Achieving visual representations of the system requires it to be split into parts that are capable of testing plausible hypothesis for understanding the problem situation. In order to keep an integrated approach, the relations presented in figure 7.4 are filtered through two different perspectives: the theoretical, based on the theoretical pathways; and the empiricist, based on the narratives described in table 7.5.

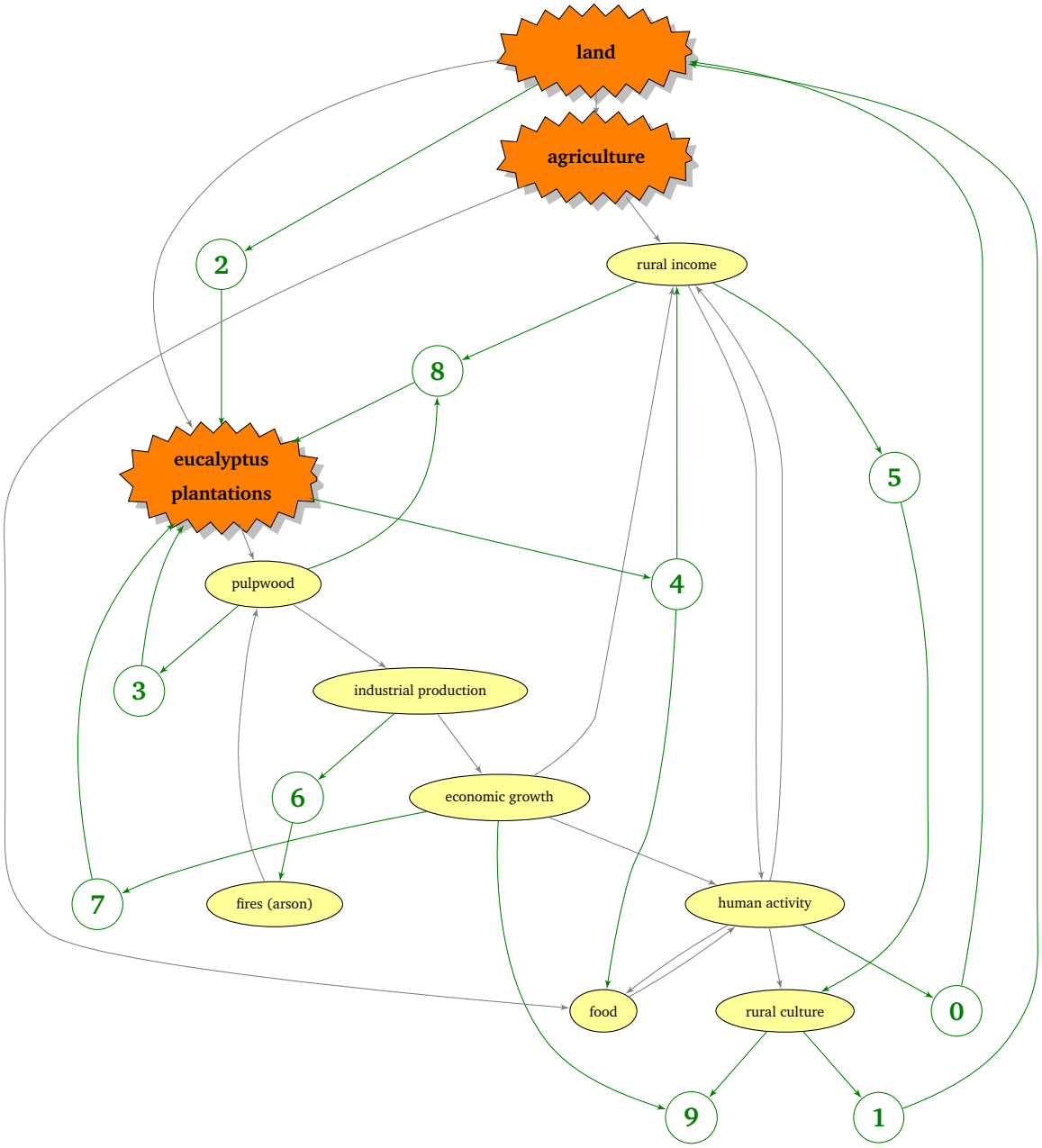

Figure 7.4: Map of the system dynamics of the eucalyptus plantations issue, according to the actors narratives, including theoretical pathways. Numbers match the literature narratives referenced in table 7.6. In short: 0 - population growth; 1 - resource consumption; 2 - industry growth; 3 - resource value; 4 - lack of entitlements; 5 - middle peasantry; 6 - fire; 7 - environmental load displacement; 8 - ecologically unequal exchange; 9 - capitalist market expansion.

7.3 Representations and impredicative loop analysis

Impredicative loop analysis (ILA) generates the ability to understand the constraints and option space of a system or holarchy. It allows the simultaneous observation of internal (holonomic) and external (non-holonomic) constraints. By applying ILA to the theoretical pathways, the analyst can try to understand whether hypercycles, or other new holonomic orders, are taking place in certain holons and to what extent they become non-holonomic orders for other holons. Identifying changes in the holons requires an evolutionary analysis. In the current *ex-post* research, this means looking at the historical evolution of the impredicative loops and their variables.

Being a recent and innovative framework, MuSIASEM is lacking proper tools (software) to represent the models. Some advances took place recently, but they have been more focused on representations for the general public. Therefore, a specific function for drawing the four-angled representations for impredicative loop analysis was developed for *The R Project for Statistical Computing* (http://www.r-project.org), which is a free and open source software with a very broad user base. The function can be considered to be in beta state, the main features in place, but there are some aspects that still need further development. The first features to be implemented were targeted at providing the possibility of creating 4-angle static representations from large sets of data, with the purpose of being included in non-interactive documents. However, the code was developed with care to allow further developments, such as dynamic on-screen interactions during the analysis.

Due to the current shortcomings of the current function, some aspects in the representation had to be tweaked. One such aspect has to do with the scales of the variables. To be able to compare different levels, different dimensions are required. A log scale could be of help here, but as this feature is not implemented, I manually adapted the order of greatness of the variables in order to have a good visualization of the different angles. As a consequence, the values of the intensive variables have incoherent dimensions (e.g. they result from a division between millions of hours and billions of hours). Even though this might seem odd to the conventional modeller, it is an issue of minor importance in this type of heuristical analysis. The objective here is

to understand trends in the variables and the relative size of compartments and flows over time and that is not affected by this tweak.

Another R function (ArrowsPlot.R) was developed during the analysis of the pathway on ecologically unequal exchange (P8). This function allows the representation of two variables (for this specific case these were indicators of material flows and terms of trade) from different holons (countries, regions), across time.

To deal with the limitations on observing of evolutionary trends under these functions, a selection of key dates was made. Three to four points in time were chosen to give a proper image of the developments in the different descriptive domains. The selection of dates was mostly sourced in preliminary analysis of x-y plots with time-series of variables that might relate to an emergent hypercycle. Function ArrowsPlot.R allows these points in time to be averaged using a moving mean around the selected year.

The developed functions (ILA.R, ArrowsPlot.R) and their source code, are being made available to the community under an open source GPL v3 license. The data used in this work is also being contributed to the community, together with the R package for the developed functions.

7.4 Selection of variables

After formalizing the problem structuring, the analyst should define a set of system qualities that can be encoded into variables for use within the set of selected models (Giampietro, 2004). Each model description has to be subjected to formalization by selecting variables that can be used to characterize the system over nested hierarchical levels, such as the whole system (level n) and its parts (level n-1, n-2, ...). The choice of hierarchical levels depends on what the analyst (or storyteller, focus group, etc.) wants to look at. For example, looking at the land use over two levels, implies looking at different spatial scales: the world can be composed of countries, countries can be composed of administrative or hydrological regions and so on. However, when mapping

time use, the parts can be some typology of activity (e.g. paid work or leisure time), or of some specific economical activity (e.g. work in agriculture or income per hour of work in agriculture). These complex space-time structures are designated by holons, as was already mentioned.

Variables used in the fund-flow 4-angle models can be separate into two types: extensive and intensive. Additionally, extensive variables can be of two types. Extensive variables 1 (EV1) are used to assess the size of the systems which can be under pressure. In the present analysis, I will use two common EV1: land area and human activity. Extensive variables 2 (EV2) are used to assess the intensity of flows, which can be associated with certain levels of production or consumption under different scenarios or metabolic profiles. In this analysis, I use EV2 from three non-equivalent types of flows: energy, materials and capital. The extensive variables are frequently referred by an abbreviation. A description on the meaning of each is present in the Glossary, while the sources of the data that was fed into the variables is presented in Appendix III: Data sources.

Intensive variables (IV) can describe a flow/fund ratio or a fund/fund ratio. They are formed from a combined representation of extensive variables and often represent a kind of technical coefficient. Intensive variables are valuable in making bridges over different compartments, delimiting the option spaces and aiding with data finding and consolidation. Furthermore, they are the main variables in the characterisation and comparison of the metabolic profiles of the different holons under analysis.

A broad criteria for selecting which variables to use for each domain, included (a) the usefulness (from the narratives), (b) the possibility of mapping to different hierarchical levels, (c) the existence of time series for the period of analysis and (d) the easiness to obtain ready-to-use data.

7.4.1 Land

Land variables are useful for checking the ecological dimension of compatibility. Their values are relatively easy to extract from FAOSTAT data on land use (FAO, 2009). The

hierarchy of variables for land use is presented in figure 7.5.

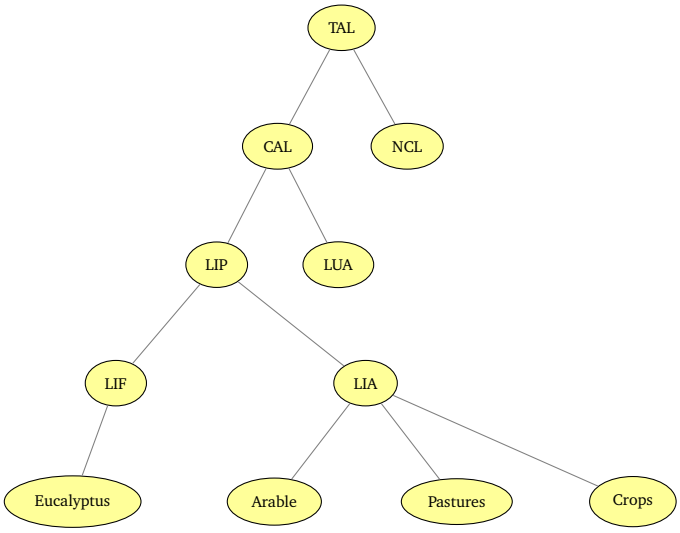

Figure 7.5: Hierarchy of variables related to land use (EV1).

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For the variable total available land, only the land area (excluding water) of the countries was considered. Most variables have been directly extracted from FAO (2009), with the exception of the following:

- CAL = LUA + LIP
- NCL = TAL - CAL
- LIP = LIF + LIA

At the international level, TAL was the only variable used in the analysis. Six world regions aggregates from FAO (2005) have been used in this thesis: Africa, Asia, Oceania, North America, Latin America, EU-15 and Other European. For congruency with other statistical data, the Other European region includes the whole area of the former USSR, since a part of former USSR countries, which are effectively part of Asia, were included in the FAOSTAT data for this area until 1991.

7.4.2 Time

Human activity (time) is useful for checking the compatibility of a given scenario or proposed project within the socioeconomic dimension.

Time use was initially aggregated into 4 activity categories, which have been suggested by several authors (according to Gershuny, 2003):

- paid work, which includes travels to work, job-search activities and full-time education;
- unpaid work, which includes cooking, cleaning, shopping and childcare;
- personal care, which includes sleep, hygiene and medical care;
- leisure time, the leftover from the other three categories.

Time use related research has frequently focused on isolating structural effects on time use to understand the behavioral changes ocurring over time. However, time is should not be seen merely as an indicator of behavioural change over time, but rather as an indicator of societal change. The data analysed by Sullivan & Gershuny (2001), which contrasts with much of the literature, reveals that structural factors such as the age, gender, employment status or family structure, are the main source of variation in time use. Together with some historical trends that have been identified, but do not constitute a large influence, it becomes possible to draw rough time use series by knowing the variations in such structural factors.

To understand social metabolic changes, a rough, macrolevel understanding of the evolution of time use suffices. As such, mapping the number of people in each typology across time provides a reasonable option for estimating the time use variables.

In Portugal there is only one global assessment on time use, made by the Portuguese National Statistics Institute in 1999 (INE, 2001b). The study categorized the time use for the following aspects:

- gender (M, F)

- age group (15-24, 25-54, > 55)
- family tipology (single, couple without children, couple with children, single parent, other)
- employment situation (employed, unemployed, student, retired, housewife/househusband, "other inactive")
- monthly family net income (< 120 thousand PTE, 120-180 thousand PTE, 180-230 thousand PTE, 230-300 thousand PTE, 300-500 thousand PTE, > 500 thousand PTE)

Of these, only the division by gender and employment situation includes the time of all respondents and not only of "those who performed the task". This means that a 24 hour balance cannot be achieved for the age group, family typology and income categories. As such, I only extracted from this study the data on gender and employment situation.

Since this was the first and only extensive study on time use in the country, these values had to be mapped to variables through a simple multiplication with the number of people in each typology. The following demographic annual series were extracted as base data:

- population demographics (sex and age)
- unemployment rate
- sectorial employment in the primary sector, agriculture and forestry
- sectorial employment in pulp and paper industry

Of particular relevance is the ability to map the working time to the different sectors of professional activity. As such, taking into account the typology of each activity categories, it seems better to consider only paid work to map into the different economic sectors. Unpaid work, for the type of tasks included, can actually be mapped to household tasks. Following the typological structure used by Giampietro *et al.* (2009),

this was merged with leisure time, to create a category of household chores+leisure and education (HC+LE). In summary, total human activity (THA), which is the total number of hours that each person has in a certain time period (24 hours in a day), is shared among the following variables:

- HA_{PO} = physiological overhead, equivalent of the personal care category
- HA_{PW} = paid work
- HA_{HC+LE} = household chores, leisure and education, also integrating the unpaid work category

Paid work was further divided for the relevant activity sectors, by using sectoral employment data. The full hierarchy of time use variables and the typologies used to estimate them is presented in 7.6.

7.4.3 Energy

Energy is itself composed by two very distinct forms of energy: endosomatic and exosomatic. In the present analysis, endosomatic energy is simply the energy of food consumed. Exosomatic energy has a slightly more complex hierarchy of variables, as represented in figure 7.7. The main aspect to retain is its subdivision into different sectors of economic activity. Households are also counting as an independent sector.

Energy flows were calculated from the data of IEA (2004) OECD Energy Balances. This database contains extensive datasets of the energy production, supply and consumption, with a breakdown over different sectors.

The following variables were used:

- Total primary energy supply, mapped to total exosomatic throughput (TET)
- Residential, mapped to Household consumption (HH)
- Total Industry Sector, mapped to Productive Sector (PS)

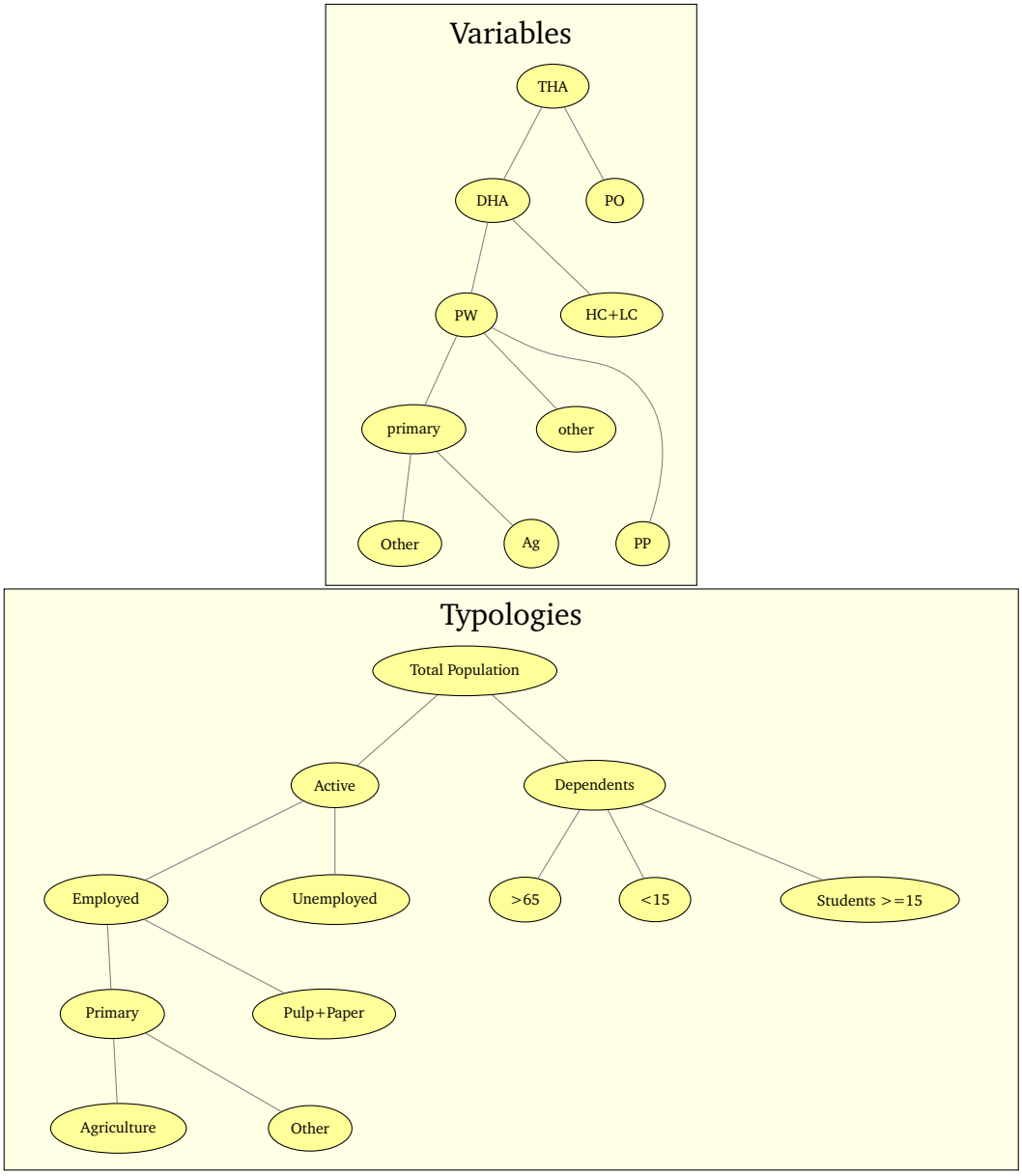

Figure 7.6: Hierarchy of variables related to time use (EV1) and the set of typologies used in their estimation.

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- Commercial and Public Services, mapped to Services and Goods (SG)
- Agriculture (includes hunting, forestry and fishery, as well as energy for traction (excluding agricultural highway use) and domestic power and heating) (Ag)
- Pulp, Paper and Printing, mapped to pulp and paper industry (PP)
- Total Transport Sector, which includes transport related to industry and households, but excludes fuel used in agriculture.

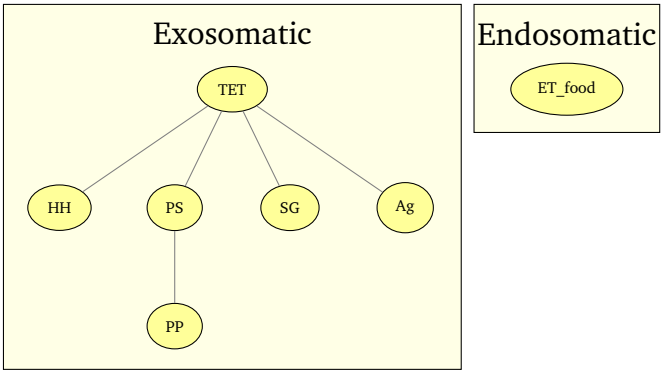

Figure 7.7: Hierarchy of variables related to energy (EV2).

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The units, available in Kiloton oil equivalent (Ktoe) where converted to GJ, using a conversion factor of 0,042 GJ per Ktoe.

Sectoral energy balances were also extracted for the paper industry and for agriculture. The energy flows indicator for the paper industry is aggregated under the category “Paper, Pulp and Printing” (ISIC Divisions 21 and 22). Agriculture includes ISIC Divisions 01, 02 and 05 and is “defined as all deliveries to users classified as agriculture, hunting and forestry by the ISIC, and therefore includes energy consumed by such users whether for traction (excluding agricultural highway use), power or heating (agricultural and domestic). Also includes fuels used for ocean, coastal and inland fishing”.

The transport related energy flows are quite significant, but in the IEA (2004) appear excluded from the sectors with which they are related (except for agriculture). Since there is an intent to link the sectoral funds of human time and the sectoral uses of energy, it is important to be able to estimate which sector is responsible for each portion of the transport energy consumption. Therefore, transport energy flows had to be mapped to the different considered sectors: HH, PS and SG. This was done by estimating the average distribution of the energy consumption for transports across the different sectors.

INE (2009a) includes data on the energy uses by sector and by primary energy source. Diesel and gasoline were assumed to be fuel types that are essentially used for transport (directly mapped to this). The gasoline and diesel flows for each sector

was then divided by the total consumption for transport of the IEA, to get proportions of transport for the available years (1995-2002). An average of the proportions of transport energy used by each sector (35% HH, 22% PS, 44%SG), was then used to map transport energy flows to the sectors used in this analysis for the whole period of analysis.

7.4.4 Materials

Variables for materials follow the Eurostat guidelines for material flow analysis (Eurostat, 2001). MF indicators were mapped across the holarchy represented in figure 7.8. A few non-standard variables were included to account for material flows specifically related with the pulp and paper industry (see Appendix II: Variables used in calculations of pulp and paper related material flows).

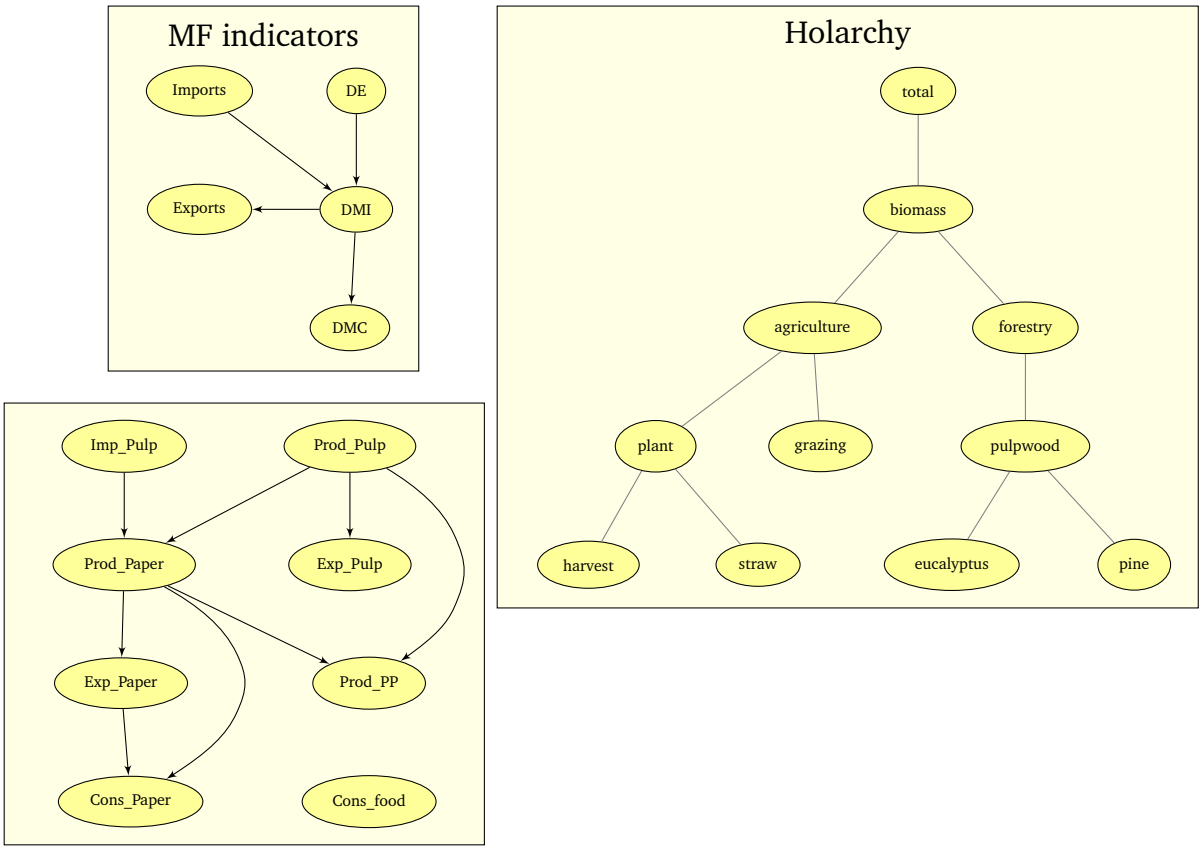

Figure 7.8: Hierarchy of variables related to materials (EV2).

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Aggregated MF indicators were extracted directly from EUROSTAT (2002) and

SERI (2008). For lower holarchic levels, MF indicators were calculated according to the methodological guidelines of Eurostat (2001). Calculation of non-standard material variables is explained here.

Data on production of biomass from agriculture and forestry was extracted from FAO (2005). The same source was used for imports and exports of agriculture and forestry, including derived wood products like paper pulp and paper related products.

Data for wood production per country and world regions is available in the FAO (2005) database. Production is a synonym of removals, which are defined as forest pulpwood removed from the forests and, therefore, is equivalent to DE. Wood volume needed to be converted to mass for analysis and comparability with other material flow accounts, as shown in equation 7.1. It was necessary to get the disaggregated data for coniferous and non-coniferous wood.

For focusing on the production of pulpwood, the data used was "Pulpwood+Particles" in the period between 1980 and 1997 and "Pulpwood,Round&Split" after 1998, due to changes in the accounting in the FAO (2005) database.

$$DE_{PP} = prod_{pw} = prod_{pw(C)} * d_C + prod_{pw(NC)} * d_{NC} \tag{7.1}$$

Where,

- $prod_{pw}$ is the production of pulpwood in weight
- $prod_{pw(C)}$ is the volume of production of coniferous pulpwood
- $prod_{pw(NC)}$ is the volume of production of non-coniferous pulpwood
- d_C is the density factor of coniferous wood
- d_{NC} is the density factor for non-coniferous wood

The density factors from EUROSTAT (2002) were used:

- $0.75\ ton/m^3$ for coniferous wood

- $0.85\ ton/m^3$ for non-coniferous wood

Wood pulp was the variable used to measure paper pulp production. This aggregate was chosen in place of pulp for paper, since the latter one also includes recovered paper and pulp from non-wood materials (such as grasses, cotton and hemp). The use of recycled paper for pulp can lead to misunderstanding of the input flows, since under the MFA framework it is better portrayed as a recycled output or as a stock accumulation. On the other hand, the present work is focused on wood based plantations and incorporating other types of fibres would contaminate the analysis.

There is also a further estimation of data for non-EU15 countries (labelled as "Other European"[1]), consisting of the subtraction of the values for FAOSTAT's aggregate EU15 to the aggregate "Europe". EU15 countries[2] were discriminated to allow consistence with the downscaling made for the national level analysis.

In trade statistics, distinction between the types of industrial roundwood is not available in FAO (2005) data after 1990. This results from a practical and statistical difficulty in defining the uses for pulpwood, logs and other types of industrial roundwood (UNECE, 2001). Therefore, the analysis of pulp related wood trade in the present research relied on the values of industrial roundwood.

Paper consumption was calculated from FAO (2005) data, using the following formula:

$$Consumption = Production + Imports - Exports \tag{7.2}$$

This calculation has necessarily some bias, since over year stocks are not accounted. Such a rough estimation should however be enough to analyse paper consumption patterns over world regions and EU countries.

[1]For FAO (2005) data, aggregation for "Europe" does not include the former USSR. Therefore, the calculated aggregation of "Other European" consists of Europe - EU15 + USSR

[2]Belgium and Luxemburg appear together in the forestry data of FAO (2005) until 1998. For this reason, the two countries are merged together and their variables summed up after 1998.

7.4.5 Capital

Economic capital is based on the simple and standard accounting of added values of production summing up for the gross domestic product (GDP). The simple hierarchy of capital related variables is represented in figure 7.9.

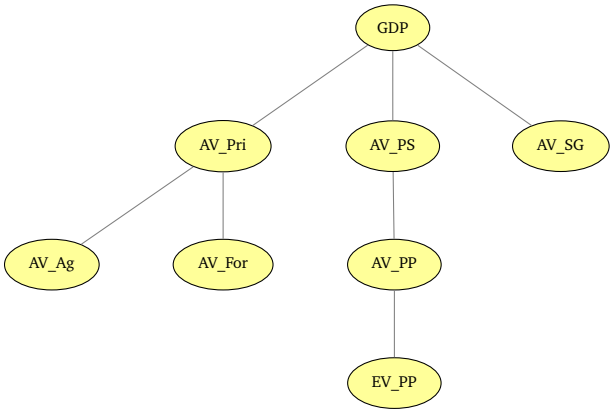

Figure 7.9: Hierarchy of variables related economic capital (EV2).

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These variables could be found in the national statistics of INE. In order to be comparable across time, they were normalized for constant values in Euro at year 2000. This was done by using the GDP deflator, except for wages, for which the general Consumer Prices Index was applied.

7.5 Synthesis

The developments in the previous chapters has made pretty clear what can be elements of the conflict against the eucalyptus plantations. By taking into account narratives derived from a set of non-equivalent descriptions, it was possible to expose and make clear the contrasting values and languages of the actors around the issue of the eucalyptus expansion.

The pre-analytical step made during this part of the work attempted to structure a problem situation that could be accepted by the full set of actors. However, following the SSM approach, I have explicitly put a focus on my storytellers, the rural population

and mountain peasants. This has the purpose of making clear their grievances, therefore spotlighting dynamics that contribute to perceived injustices that precede conflict. Theoretical pathways have provided further perspectives for the analysis, by integrating different narratives extracted from state-of-the-art literature with the narratives from the storytellers.

Conventional environmental conflict analysis often fail to bring a rich enough problem description that can give adequate answers. They frequently neglect dynamics happening at different levels. They also tend to focus on a single descriptive domain, which is dependent on the area where the research team is originally coming from.

Applying the framework of multi-scale integrated assessment of social and ecological metabolism (MuSIASEM) to the analysis of environmental conflicts seems to be able to bring together the background of existing environmental security and conflicts theories, even when they seem to have no point in common. This is achieved through the ability to represent in parallel non-equivalent descriptive domains and to navigate through the different narratives of the structured problem.

Chapter 8

Analysis of pathways

> "There is the fact that Time always flows but never exists as a stock"
>
> — Nicholas Georgescu-Roegen, The Entropy Law and the Economic Process (1971)

In order to adapt the different narratives associated to the pathways to the current study, one must try to understand if and where is an hypercycle generation that leads to disruption of the reproduction of existing metabolic profiles.

8.1 Population growth (P0)

An hypercycle between population growth and resource scarcity would mean that resource extraction and use is driven by population growth, rather than changes in the intensity of use of the resources (for example due to changes in consumption patterns). In terms of formalization within the specific problem situation, the hypercycle might take place when at least part of the following dynamics are taking place:

1. a growth of world or Portuguese population;
2. an increasing paper consumption in the world;
3. an increasing area in forestry;

4. a growing biomass extraction, pushed by the extraction of raw materials for the pulp and paper industry;

5. a decreasing food insecurity, derived from a reduction of land available for agriculture, decrease of food production or increase of food consumption.

I start by analysing the evolution of paper consumption across world regions presented in figure 8.1. The figure shows that global paper consumption is increasing, particularly due to the effect of north America, EU15 and Asia. Asia has a particularly strong role in pushing consumption levels up.

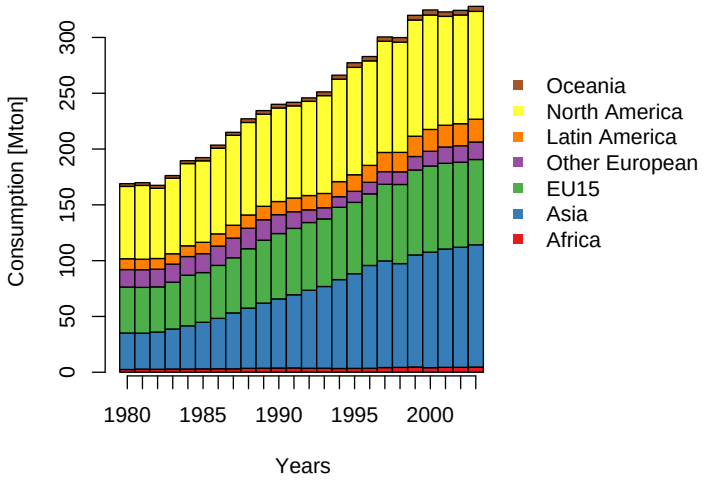


Figure 8.1: Paper consumption across world regions

Figure 8.2 shows that there is a population growth. This is more evident at the global level, with a continuous growth between 1980 and 2003. At the Portuguese level, the growth rate is much smaller (please note that the axis are not proportional). It shows, however, interesting inflections, probably related with migration patterns. Based on the inflection points, I decided to fix the dates for the analysis of the effects of this hypercycle in the inflections around 1980, 1985, 1990. I further added the date of 1995 in order to have a post-conflict point of analysis.

The analysis of the set of representations in figure 8.3, shows us that there is a continuous increase of paper consumption linked with an increase of the world population

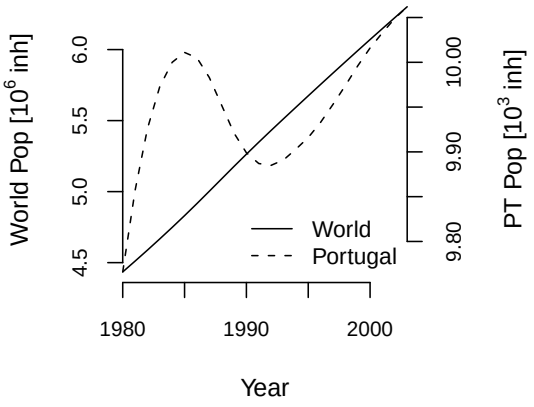


Figure 8.2: World and portuguese population evolution

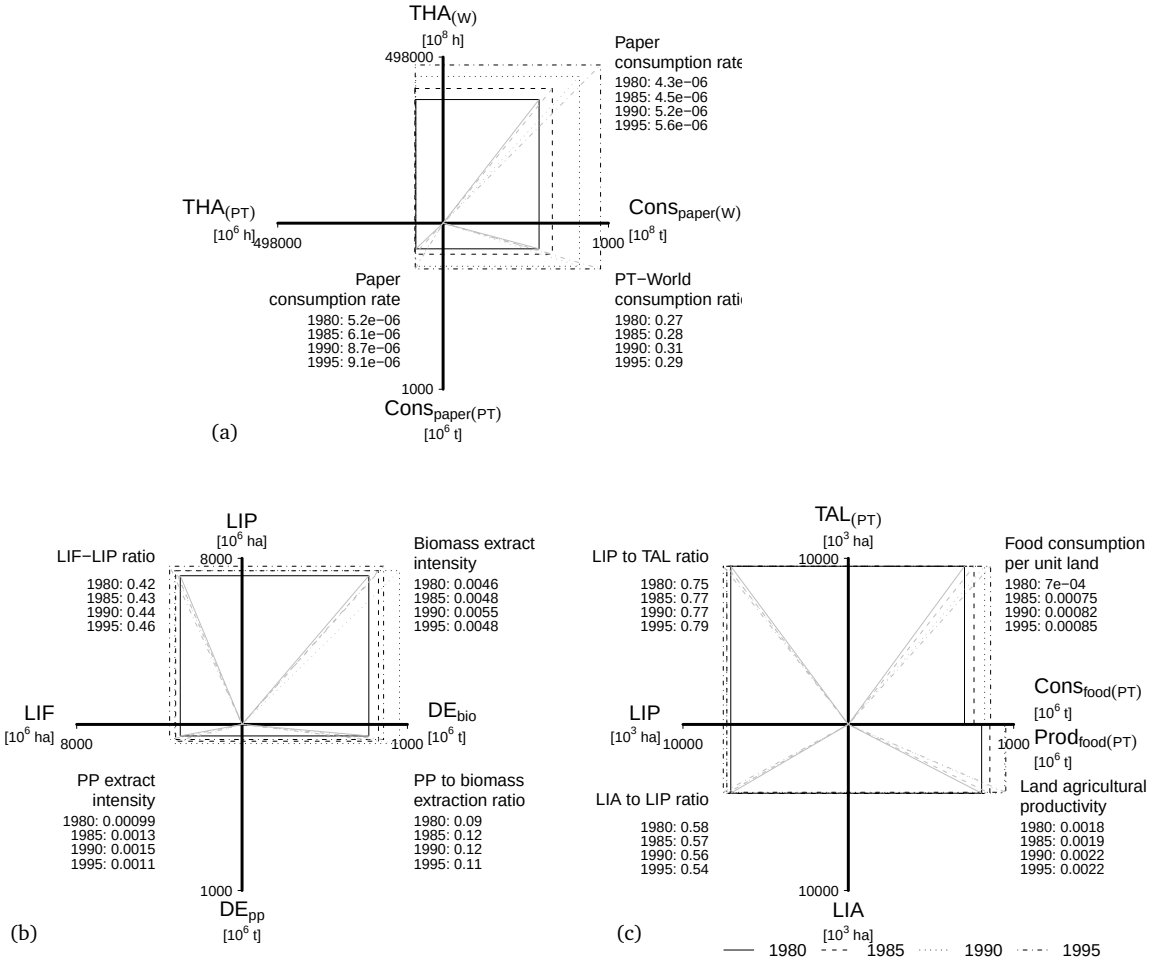


Figure 8.3: Impredicative loop analysis for the population growth pathway (P0).

(a). Until 1990, this increase appears together with an increase in biomass extraction (DE_{bio}) and with the extraction of pulpwood (DE_{pp}).

The extraction of resources went at a faster pace than the occupation of new lands, at least until 1990. This has been supported by an increase in the extraction per unit of land, given by the IV "biomass extraction intensity" and "PP extract intensity" (b). Furthermore, there was an increase of land in forestry, which supported the increased extraction of pulpwood. However, by 1990, a peak in the extraction of pulpwood (50% increase compared to 1980), followed by a sharp decline in the 5 following years, could point to a resource scarcity situation.

This temporary resource scarcity appears independent from population growth at the national level. 1990 marks a period of contraction of the Portuguese population, in countercycle with the resource extraction. After 1990, as domestic extraction contracts, population growth, both in Portugal and in the world continue to increase.

Curiously, despite this apparent resource scarcity by 1990, the binary tension between land in agriculture versus land in forestry did not take place. Land classified as having an agricultural use was not reduced, pushing the variable land in production to higher levels.

At a macro level, scarcity does not seem to play a role at threatening food security. In fact, production of food has been growing at a faster pace than food consumption, as a result of the intensification of agriculture.

8.2 Resource demand (P1)

This pathway attempts to relate scarcity to complex social and environmental processes that can be understood from the formalizations of technical coefficients. In particular, it dives into Barbier's adaptation of the Romer-Stiglitz model (see Homer-Dixon, 1999, p.131).

The hypercycle that could occur from this is one where changes in the metabolic

profile lead to an increased consumption of resources, which would positively feed an increasing resource extraction. Such an hypercycle creates an understanding that available resources are or will not be enough to supply the growth, therefore pushing further new frontiers of resource extraction. On the other hand, technical improvements are not capable of attenuating the increasing demand for resources.

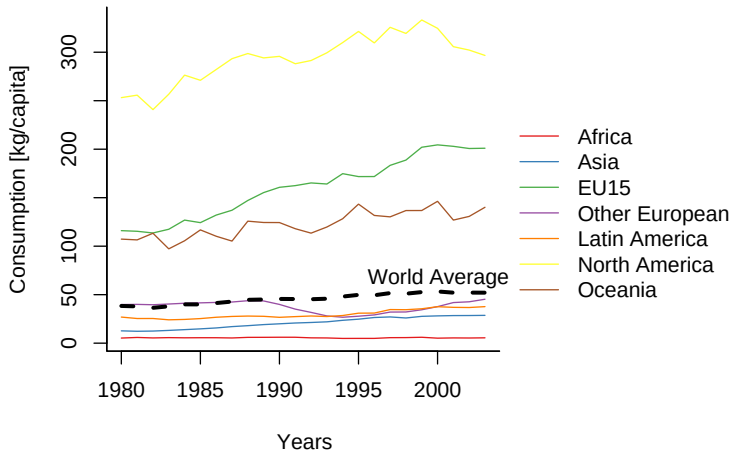


Figure 8.4: Paper consumption per capita across world regions

Figure 8.4 shows, unsurprisingly, that North America and the EU-15 region are the largest per capita consumers of paper. In fact, this discrepancy is so high that these regions total paper consumption is higher than that of the populated Asia (figure 8.1). EU-15 has the highest increase of paper consumption, followed by North America. Asia and Latin America also increase per capita consumption, but at a much lower rate.

Figure 8.5 puts in contrast the evolution of paper consumption in Portugal and the world. From there, I selected as dates for use in the ILA, the inflection point of 1982, together with the consumption peaks of 1989 and 1996.

Figure 8.6(a) depicts the relation between land use and resource extraction (pulpwood), while figures 8.6(b) and 8.6(c) focus on the efficiency of the conversion process from wood to pulp and from pulp to paper. At the national level, consumption increases steadily over time.

The most important results appear in the intensive variables ”resource extraction

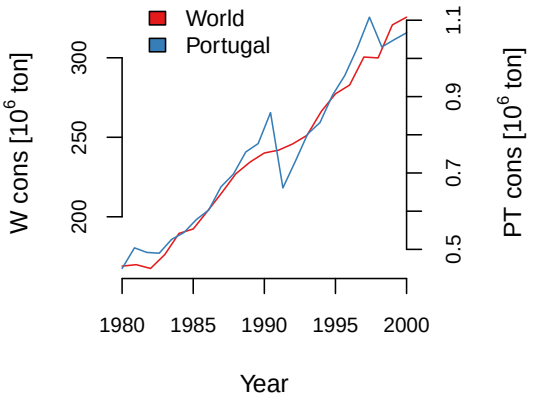


Figure 8.5: World and portuguese paper consumption evolution

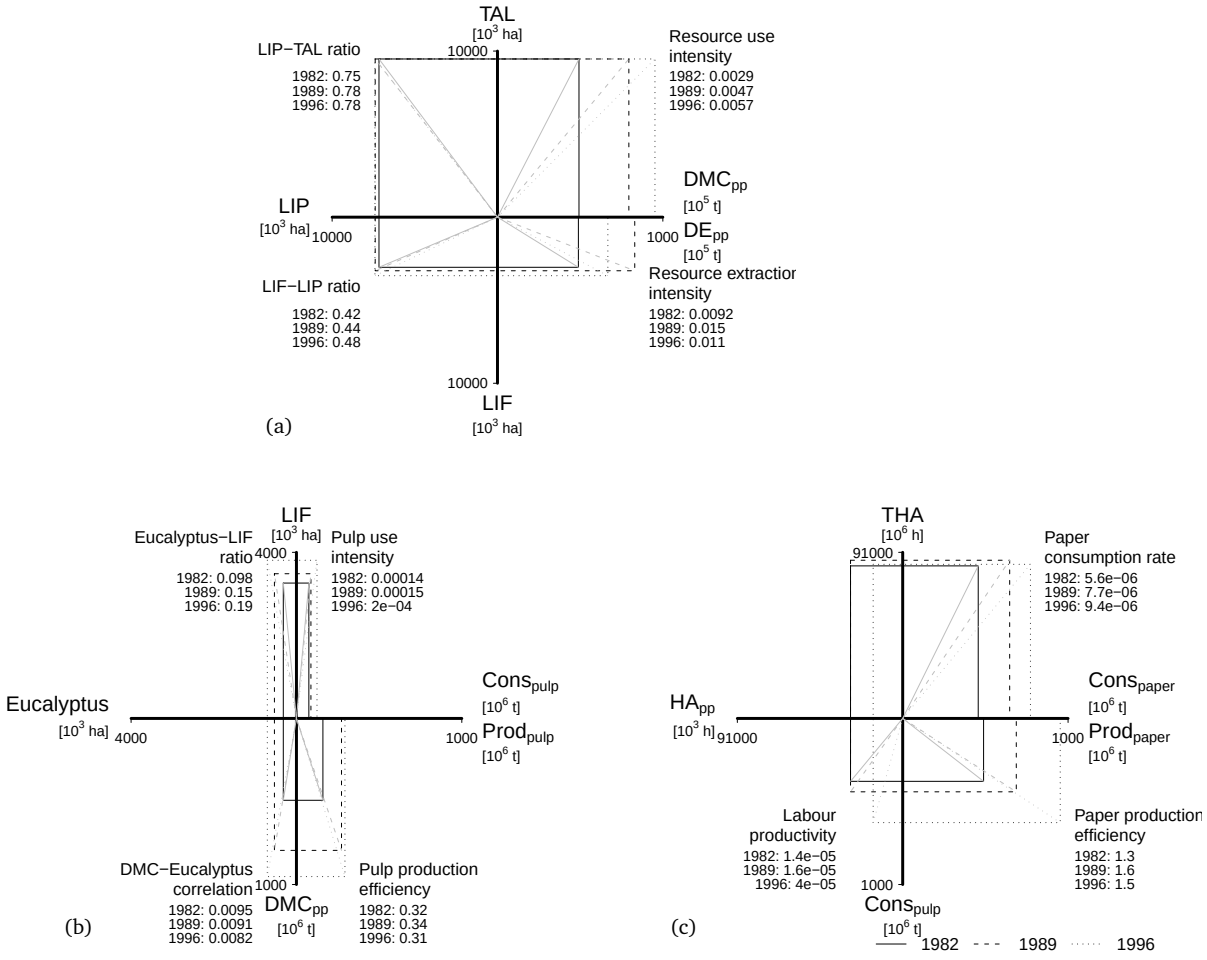


Figure 8.6: Impredicative loop analysis for the resource demand pathway

(P1)

intensity“, “labour productivity“ and ”production efficiency“. These variables relate land use with extraction of raw materials for the industry and labour in the industry with the production process.

”Labour productivity“ has a strong increase over time, as a result of declining labour levels, together with increasing pulp extraction. Both the decline in employment levels and the increase in pulp use are more intense between 1989 and 1995. This result suggests that structural changes took place in the sector during this period.

The resource extraction intensity and production efficiency of both pulp and paper reach its highest level by 1989. Another interesting observation to make is around the differences between DMC and DE. Until 1989, DE was over DMC, suggesting that the paper sector was able to internally supply its demands. However, after 1989, DMC increases without being supported by an equally increasing DE.

8.3 Resource capture (P2)

This is the last of the theoretical pathways which directly relates resource scarcity with conflicts (see Homer-Dixon (1999)). Here, elite control over resources (resource capture), could mean, within the analysed problem, the control of land by powerful economical or political groups to supply the demand of raw materials by an expanding pulp industry.

As such, the formalization requires a model that links the economic performance of the industry with the expansion of the eucalyptus plantations or land for forestry, at the expense of land for agriculture. In terms of conflict potential, the rush for lands for eucalyptus afforestations might have hindered peasants access to land for agriculture or pastures (peasant identity, land use descriptive domain).

Not surprisingly, the worldwide market of paper is a growing one, as we can see in 8.7.

Figures 8.8 shows a very pronounced expansion of the productive sector starting

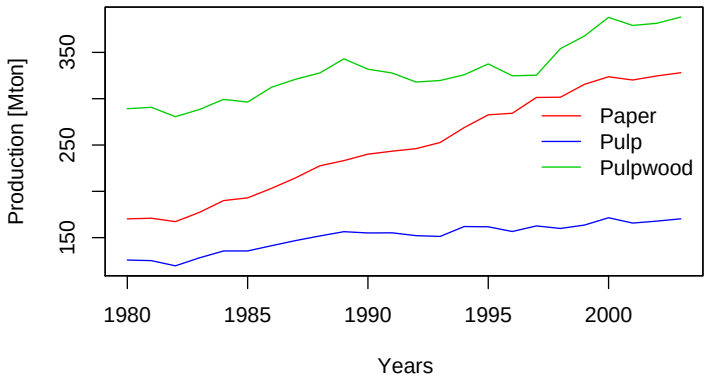


Figure 8.7: World production of paper, wood pulp and pulpwood

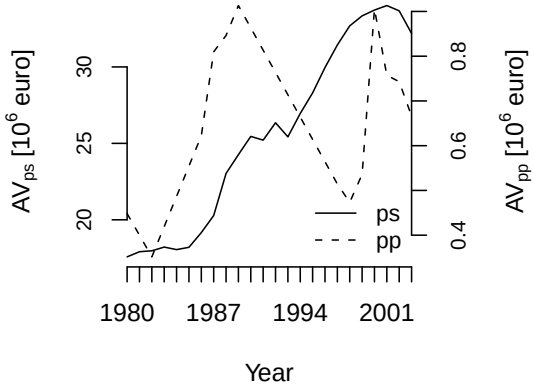


Figure 8.8: Added value of the pulp and paper industry (pp) and the productive sector (ps)

with the entrance in the EEC in 1986. The pulp and paper sector, despite having an overall growing trend, exhibits a cyclic pattern of expansion and contraction.

Four periods of analysis where chosen for the representations (figure 8.9): 1981, as a base point, with a non-growing productive sector and a slight decrease in value of the pulp and paper sector; 1985, the year after the installation of the pulp mill in Figueira da Foz, where an intense growth of the pulp and paper sector is taking place; 1989, the conflict year, marked by a peak in both the pulp and paper sector and the overall productive sector (which slows down growth); and 1993, where the pulp and paper sector is decreasing value in countercycle with the productive sector.

Representation 8.9(a) replicates part of what was already shown in figure 8.8: an

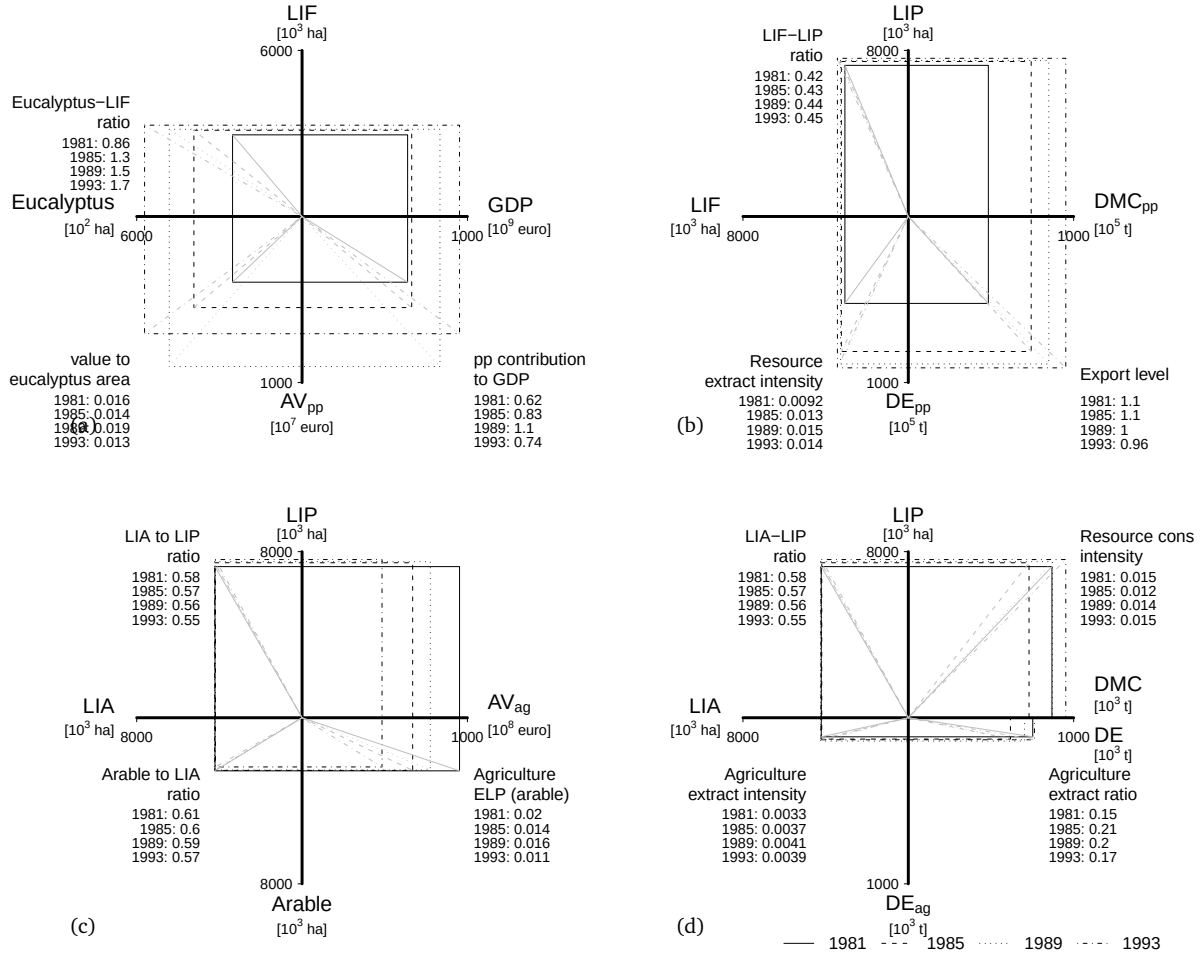


Figure 8.9: Impredicative loop analysis for the resource capture pathway (P2)

increase in the importance of the pulp and paper industry, reaching a peak in 1989, with a 1.1% contribution to the GDP. Additionally, it relates this economic growth and the expansion of the pulp and paper sector with an increasing area of eucalyptus and forestry.

However, only by looking at 8.9(b) that it is possible to verify something useful for the analysis of a demand induced resource scarcity. First, by comparing the domestic extraction with the domestic material consumption, a decline in the material trade balance of the pulp and paper sector becomes visible (IV2 “Export level” decreases). Moreover, if one considers forests as the main source of material input to the sector, then the intensity of extraction of resources has reached a peak in 1989. It is also relevant to note the most proeminent growth of this variable between 1981 and 1985 (43%).

Representation 8.9(d) links resource consumption (DMC) and extraction (DE) at the national level with resource extraction related to the agriculture sector. This can provide an indication on whether increased resource consumption is linked with a growing extraction of resources and whether this is competing with resources from agriculture. There is a slight increase of the material consumption in Portuguese society up to 1989. Curiously, this appears decoupled from the extraction of resources, which actually decreases, meaning that material imports have earned importance. After 1989, the rate of consumption accelerates and pushes a growth of domestic extraction of resources. Imports also continue to grow in proportion, as seen by the increasing distance between DMC and DE. The increase of extraction intensity until 1989 could signal a growing resource scarcity situation, driven by an increased consumption of the sector.

The resource access of the agriculture sector does not seem to be significantly affected, both in terms of material extraction and land use (representation 8.9(c)). Land in agriculture remains relatively stable, showing only a slight decrease after 1989, while domestic extraction actually grows and follows the trend (given by IV "agriculture extract ratio") of the overall national domestic extraction.

A more in-depth look at the profile of LIA might provide further information. Representation 8.9(c) shows that while land in agriculture did not decrease, arable land did suffer some reductions. However, this reduction is mainly taking place after 1989, which might propose that the sectorial value increase that took place in this period acted as a buffer to maintain most agricultural lands in its current use.

Figure 8.10 gives a more detailed overview on the profile of subcompartments of LIA. Permanent pastures show a major increase after 1990, together with a equal sized reduction of arable lands.

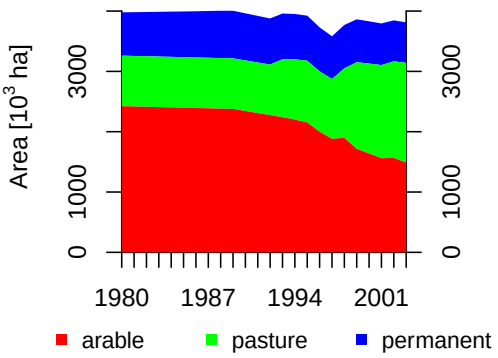


Figure 8.10: Evolution of the subcompartments of land in agriculture (LIA)

8.4 Resource value (P3)

The observations of de Soysa (1999, 2002b) relating conflicts to a struggle to control valuable abundant resources are made in a substantially different context than the eucalyptus struggle. The author notes that this pattern of natural resources capture by rebel groups can be used to finance civil conflict - the ”honey pot“ (de Soysa, 2002b). It is important for renewable resources such as timber, land or pastures, a moderate to high availability appears related to conflict in poor countries (de Soysa, 2002b), contrarily to the resource scarcity and conflict theories transposed in pathways 0 to 2.

My proposal is to transpose the empirical findings of de Soysa (2002b), relating the resources as a source of funding, to the following statement: highly valued resources (pulpwood, pulp and/or paper) have capitalized (potential) forest owners and/or the pulp and paper industry, thus influencing the expansion of eucalyptus plantations.

As such, this pathway should be tested by looking at the existence of an hyper-cycle between the prices of pulpwood, pulp or paper and the expansion of eucalyptus plantations.

Figure 8.11 shows the fluctuations in the prices of pulpwood, pulp and paper. It is particularly interesting to note the sudden increase in the price of pulpwood after hitting the bottom in 1983, up to the maximum in 1990. These prices seem to follow an opposite trend to that of pulp and paper. Pulp shows a decreasing price tendency after reaching a maximum in 1984. Paper follows approximately the same pattern until the

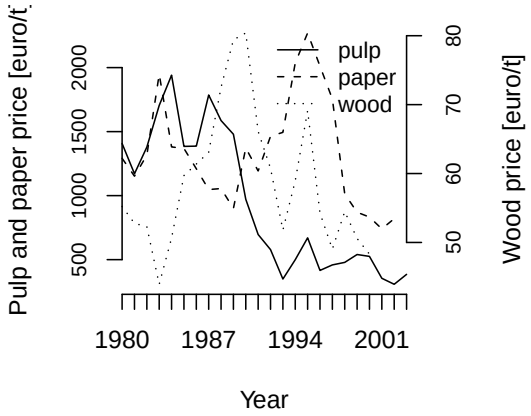


Figure 8.11: Prices evolution for pulpwood (at the entrance of the factory), pulp (export value) and paper (export value).

end of the decade. However, during the 1990s pulp prices remain relatively stable and low, while paper reaches its maximum price in 1995.

To understand whether there is an hypercycle between the value of resources (considering pulp and paper also as "resources") and the expansion of eucalyptus requires a selection of dates that can touch the different price trends:

1. 1981 - pulpwood low, pulp and paper at moderate prices, but reaching a minimum;
2. 1984 - pulpwood reaching an historical minimum and pulp an historical maximum, while paper price starts to decrease;
3. 1987 - pulpwood and pulp high, but pulp decreasing steeply after this date; paper low;
4. 1993 - wood and pulp low (nearly historical minimum), paper high (historical maximum).

Representation 8.12(a) from figure 8.12 shows the expansion of the pulp industry system under the land and economic descriptive domains. Value for the industry and land used for eucalyptus are expanding together during the 1980s, but value decreases significantly in the following decade.

In 1984 there is a very pronounced increase in the export value, together with a

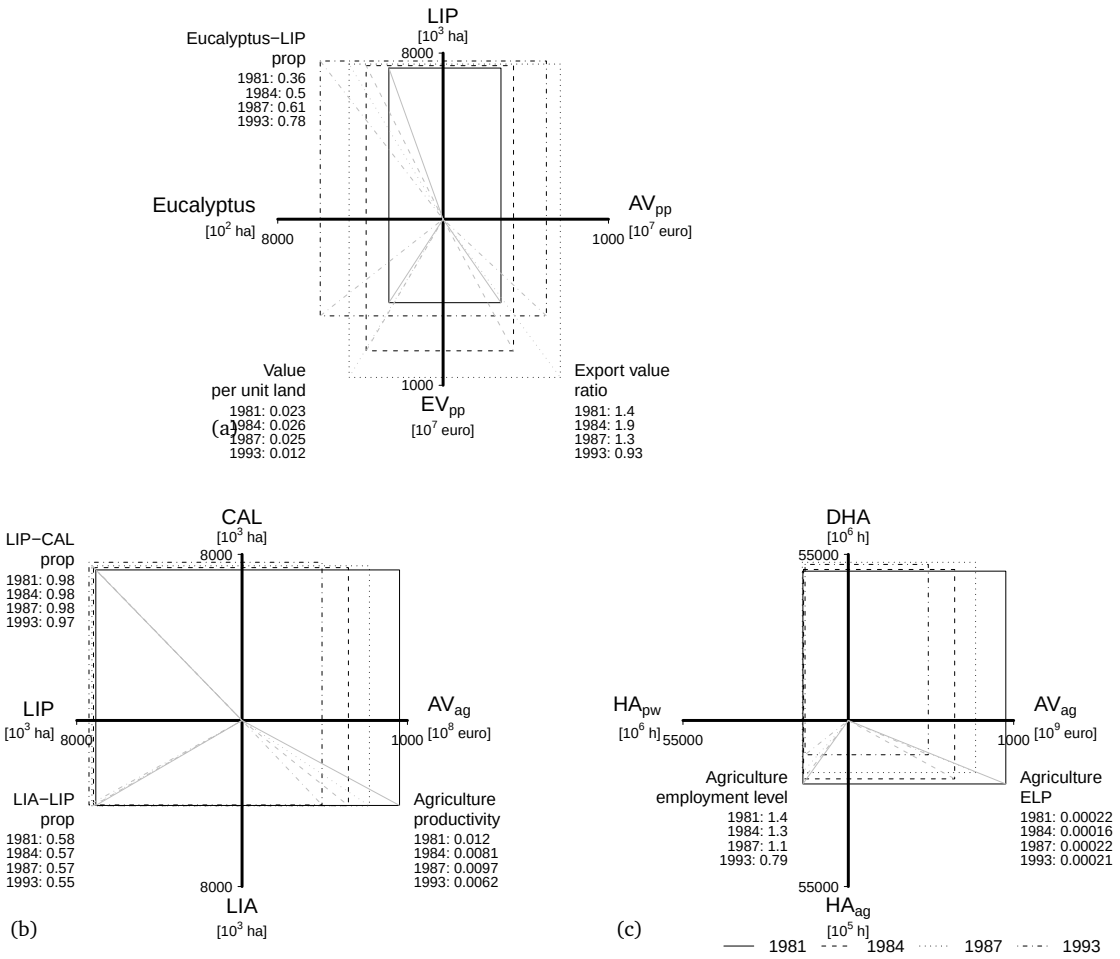


Figure 8.12: Impredicative loop analysis for the resource value pathway (P3)

not so relevant growth of the added value. The export value ratio reaches its highest level, together with the historical maximum of pulp price, showing an high dependency on pulp exports for the pulp and paper sector. As such, the rise on the price of pulp might have been a key element in the capitalization and expansion of the industry during the 1980s. In fact, at least up to 1993, paper prices do not seem to play a role in the sector economic performance. The historical maximum of paper prices in 1993 was not able to compensate value losses apparently related with the low prices of pulpwood and pulp.

This leads to an interesting evolution of the intensive variable “Value per unit land”. High in the 1980s, it suffers a sudden drop in the 1990s, as the eucalyptus plantations continue to expand.

8.5 Lack of entitlements (P4)

Projecting Sen entitlements theory and Fraser *et al.* (2003) concept of agroecological vulnerability to the current analysis, ould mean that communities which are conflicting against the eucalyptus plantations are vulnerable.

Conflicting communities vulnerability can be defined according to the dependency on a certain land use, which should be able to provide either food for self-consumption or income to support the existing metabolic profile. If the system analysed according to these values and domains appears to be under strong constraint, then the pressure of conversion of land to eucalyptus plantations, might be a significative one.

This situation of vulnerability might lead to an hypercycle between reduction of incomes (rural and peasant identities, capitalist descriptive domain) and/or decreasing self-provisioning of food (peasant identity, food security descriptive domain) and the expansion of eucalyptus afforestation. Collapse of the peasant or rural communities (understood as metabolic changes) can further contribute to increase the availability of lands for afforestation, increasing the vulnerability of the socioecological system. This vulnerability can be roughly evaluated by the patterns of land use and through the reduction of rural entitlement opportunities, formalized as the possibility to generate money or food from the land available.

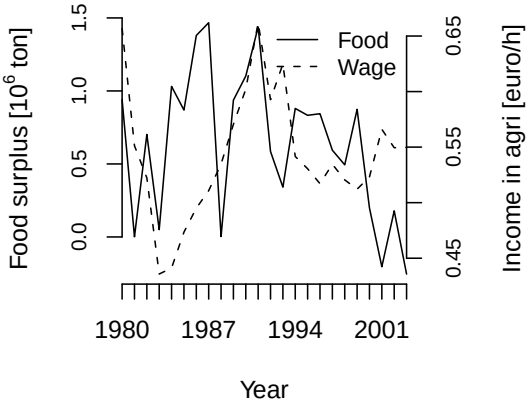


Figure 8.13: Evolution of food surplus and average income in agriculture

Figure 8.13 is an attempt to roughly understand constraints on the entitlements of peasants or smallholders. It is drawn from the simplistic assumption that peasant

entitlement options consist of a dualistic land use function, which either allows food production (for self-provisioning) or income (through the sale of food products, to buy food and goods).

In order to have a representative set of dates for ILA analysis, the following points were selected:

1. low food, low wage (1983)
2. low food, high wage (1988)
3. high food, high wage (1991)
4. average/high food, low wage (1999)

The representations in 8.14 attempt at relating land use with the two entitlement options (income and food self-sufficiency).

Representation 8.14(a) shows that both food production and food consumption increased over time. The increase in food consumption is steady in the analysed period, as a result of an increased consumption per capita (not shown in this representation, but analysed in figure 8.32), rather than a population increase. Production, on the other hand, expands in a leapfrog fashion, pushed by strong increases in agriculture productivity happening in the end of the 1980s.

It is obvious that representation 8.14(a) gives only a very limited overview regarding the food self-provisioning of the rural country and even more of communities. However, the use of the impredicative loop enables the deduction that the food surplus of the 1990s results from an expansion of industrial agriculture which in turn is related with a decline of self-sufficiency ways of living.

Representation 8.14(b) opens space for several interpretations. The most immediate observation is that agricultural added value has an overall decline over the two decades. However, this decline is strongly reversed between 1988 and 1991. By looking in parallel with representation 8.14(a), some explanations can be advanced. One, direct, is that the food surplus brought by the sudden increases in productivity

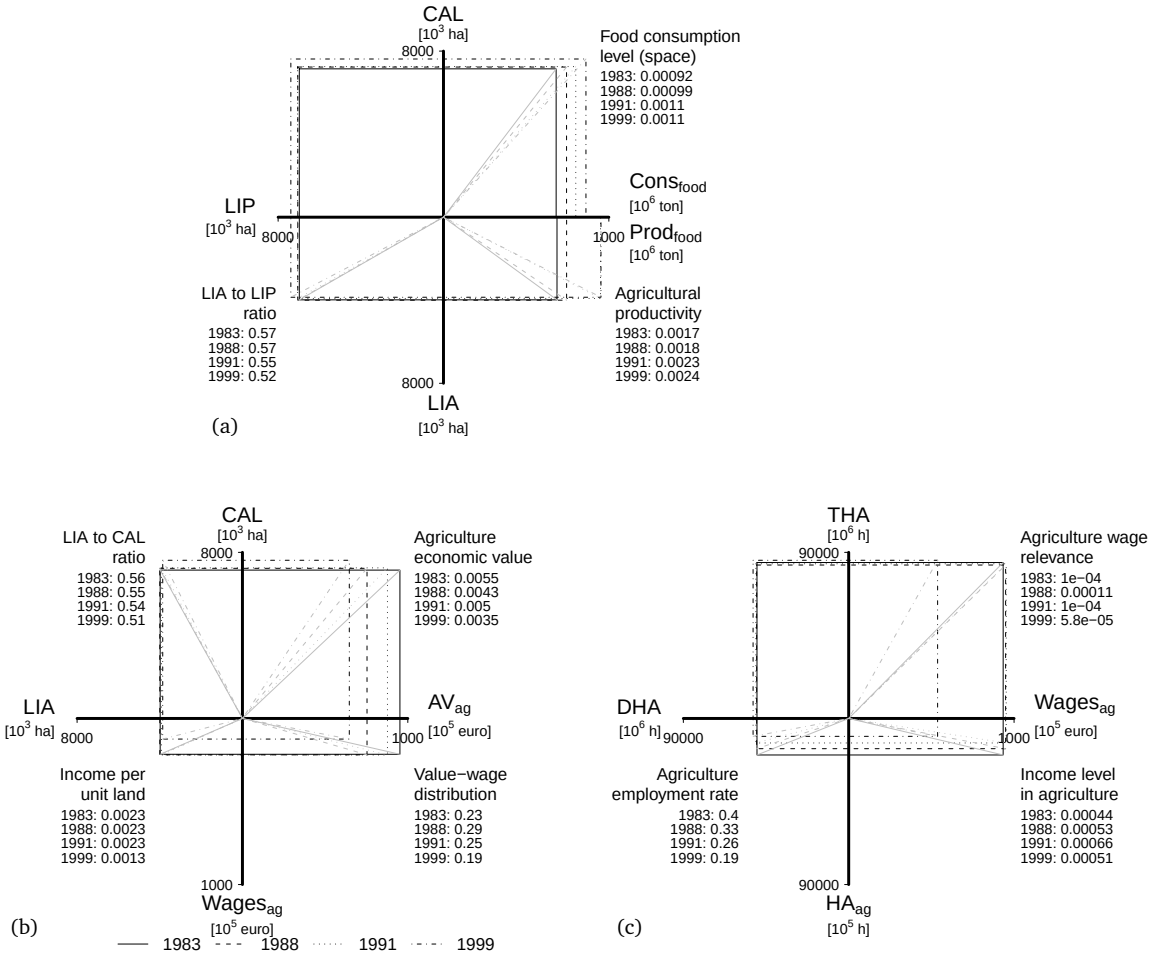


Figure 8.14: Impredicative loop analysis for the lack of entitlements pathway (P4)

allowed the increase of exports. The other is that the higher penetration of agriculture in the market allowed for the commodification of food products and, therefore, to an increased accounted added value of agriculture.

The most curious element is that of wages. The total amount of wages - and also of income per unit of land - only decreases after 1991. This happens despite the reduction of the work in agriculture, leading to an increase in the average income level (representation 8.14(c)). This parallel observation of 8.14(b) and 8.14(c) regarding income levels and employment, suggests that the reduction of work in agriculture, up to 1991, happened mostly among the lower income strata of rural workers.

It seems plausible that this lower strata of farmers has suffered from entitlement loss, particularly during the period between 1988 and 1991. A reduction of income

opportunities has almost certainly happened. It is also possible that lands in agriculture changed function, from majorly self-provisioning to more economically productive forms of agriculture.

8.6 Middle peasantry (P5)

> "It is the very attempt of the middle and free peasant to remain traditional which makes him revolutionary"
>
> — Eric Wolf, Peasant Wars (1969)

In this pathway, I hypothesize that a new peasantry class, with a higher potential to rebel, exists in periods of more intense conflicts. On one hand, increases in agriculture productivity are able to generate a source of income that allows the creation of this new peasantry class. A scenario of increases in wages at the societal level the relative advantage to wages in agriculture, might stimulate the creation of urban linkages through the increase of off-farm work value. Increasing income for peasants either through agriculture or off-farm work, opens a window for the emergence of a peasants class with higher potential to rebel, the middle peasants, with lower constraints (or more entitlements).

The observation of representation 8.15(b) shows that in 1989, the time spent in paid agriculture was in decline, but the average income was increasing. Still, it has lagged behind the average societal wage level. This relatively unfavourable income for agriculture is only visible after 1986 and intensifies in the beginning of the 1990 decade.

It is also between 1986 and 1989 that the value of agriculture (and its average economic productivity per unit land) had a temporary increase (representation 8.15(a)). An additional variable to bring into the analysis is the value-wage distribution, previously shown in representation 8.14(b). It is also in the late 1980 decade that the distribution of the value generated by the agriculture activity to paid agricultural work reaches its highest level (29%).

Representation 8.15(c) shows that the intensification of material extraction in

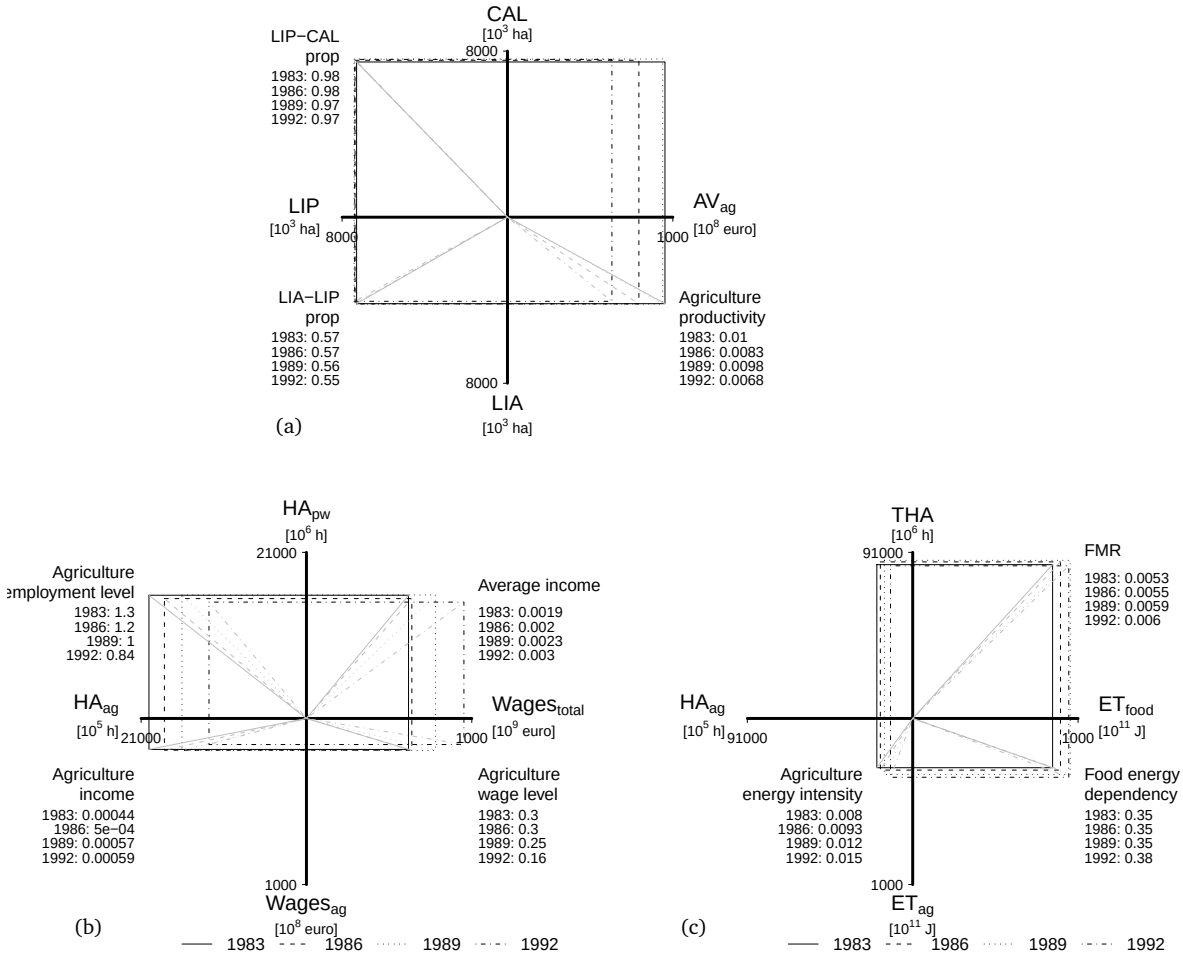


Figure 8.15: Impredicative loop analysis for the emergence of middle peasantry pathway (P5)

agriculture (IV3) has allowed food production to remain in material surplus over time, despite the increasing consumption. The food metabolic rate (FMR) in representation (f) gives a perception of the changes in the food consumption patterns. Hourly intake of endosomatic energy increased from 53 J/hour in 1982 to 59 J/hour in 1989, a 11% increase. The same amount of land and a smaller workforce is able to a richer diet because the exosomatic energy intensity of agriculture has grown by 173% between 1982 and 1989 and continued to grow thereafter. External inputs, such as fertilizers, herbicides and all kinds of fossil fuel dependent machinery have replaced the circular and slower flows of energy and materials in agriculture, as well as human labour. The result has been an increase in the amount of energy used in agriculture in proportion to the energy provided by the consumption of food at the societal level. This means an increased exosomatic energy dependency of the Portuguese food system.

These concurrent dynamics - decline of paid work in agriculture, increase of average incomes in agriculture, but lagging behind with the societal level of income and the higher distribution of value for wages - suggest that relatively strong transformations operated in the rural world after the entrance in the EEC. In particular, these effects propose that there could have been a temporary increase the conditions of living of peasants, before a further concentration and industrialization of agriculture took place.

Increased economical income of the affected groups, creating “middle peasants“ could have generated empowerment to rebel against the continuous expansion of eucalyptus. Furthermore, the increased rural linkages potentially brought by off-farm work might have created a point of attachment with the emerging environmental movement.

8.7 Fire (P6)

In this pathway, I will look at the Pyne (2006) relation between the increase of fires during periods of change under a very specific narrative: the Portuguese paper pulp industry expansion and land use conflicts regarding eucalyptus plantations are related with an increasing number of fires in the country. Opposers of the eucalyptus expansionism accused the paper pulp industry of “sponsoring” forest fires to serve their economic interests. This accusation raised a big deal of public anger against the paper pulp corporations and interests. In order to understand the existence and impacts of a fire hypercycle, the number and intensity of fires can be related with different descriptive domains, particularly those of capitalist economics, land use and material flows.

In particular, this analysis aims at bringing an understanding of the entailment of processes of (pulp)wood demand, land demand and forest fires. Impredicative loop analysis can bring important insights of whether such processes were hypercyclic. Forest fires can be seen as a catastrophic event that either disrupt the existing adaptive cycles or are itself embodied in socioeconomic and ecological changes. If the hypercycle can be observed, then it means that setting up a paper pulp factory was disrupting the existing equilibrium and projecting the system into a fast phase of disruption.

Before moving to a more integrated assessment, I will first look at the relationship between fires and material flows indicators. These help us understand whether the described hypercycles have really been set in motion by the increasing paper pulp demand and which variables can provide better information within the ILA.

A Pearson correlation between the fires and the biomass material flows datasets (table 8.1), shows a strong positive correlation between the number of forest fires and the material flow indicators for biomass.

	harvest	DE	DMI	DMC
Number	0.14	0.80	0.87	0.88
Area	0.27	0.41	0.41	0.38
Forests	0.25	0.24	0.24	0.19
Bushes	0.26	0.62	0.63	0.62

Table 8.1: Pearson correlations between forest fires and biomass material flow indicators

These correlations are further developed by the plot analysis of Figures 8.16 and 8.17. There is a strong linearity between the number of forest fires and the biomass material flow indicators domestic extraction, domestic material input and domestic material consumption. R^2 values between 0.65 and 0.78. On the other hand, there is no significant correlation between the burned area and these same indicators, even when the 2003 burned area value is considered an outlier.

It is important to be careful when drawing conclusions from this correlations, as correlations can be merely coincidental and have no entailment. The increase in the number of forest fires tells that something within the system has changed, while the correlations suggest increased material flows are somehow related to the system instability. However, it could be a merely coincidental correlation without entailment. An ILA might be able to provide more clues on the fire hypercycle.

In order to allow a selection of data points for the ILA, figure 8.18, represents the evolution of the number and area of forest fires with the material flow indicators DE and DMC specific of the pulp industry (PP, which, should be reminded, is exclusively

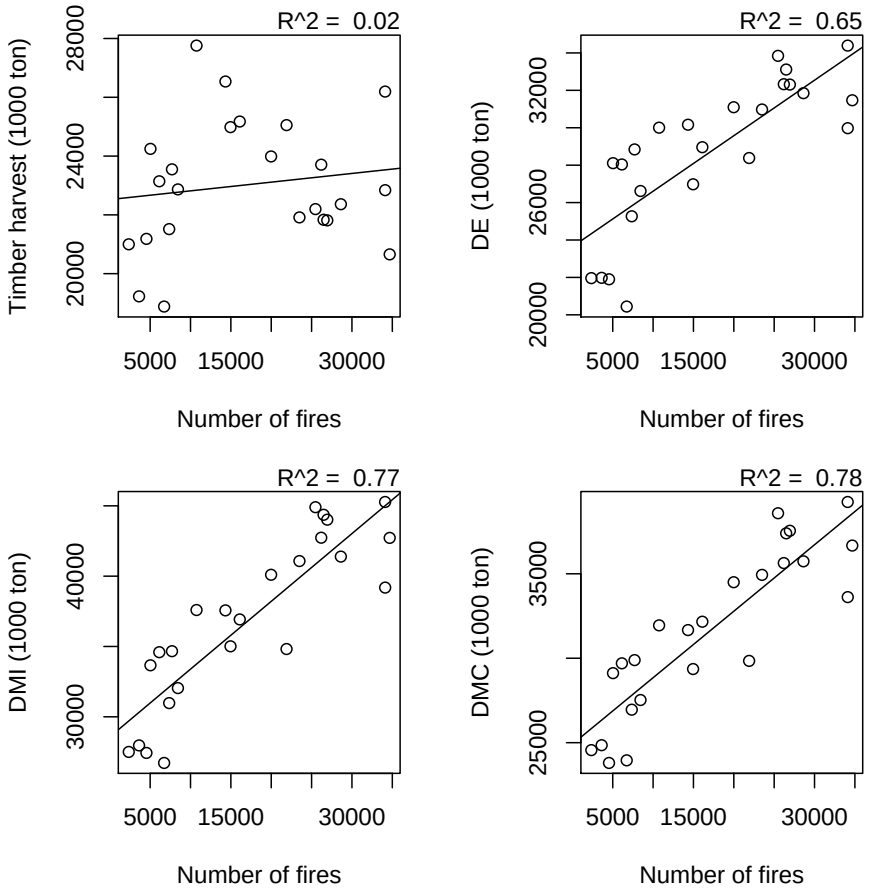


Figure 8.16: Bivariate plots between number of fires and biomass material flow indicators

related to pulpwood material flows).

The number of fires increase in number in 1985, but the most interesting increase happens in 1989. 1985 also has a peak in the area burned, with the major part of it (54%) being forest land. The 1985 peak of number of fires and burned area appears in the middle of a sudden growth of domestic extraction of pulpwood, which occurs between 1984 and 1986. In fact, both DE and DMC started to increase after 1982, intensifying after 1984 and lasting until 1991-92.

The first peaks on the number and areas of fire are related with the increase of the installed capacity of paper pulp production brought by the Soporcel factory. The second peaks coincide with the higher intensity of conflicts and appear to be more related with the increasing material flows.

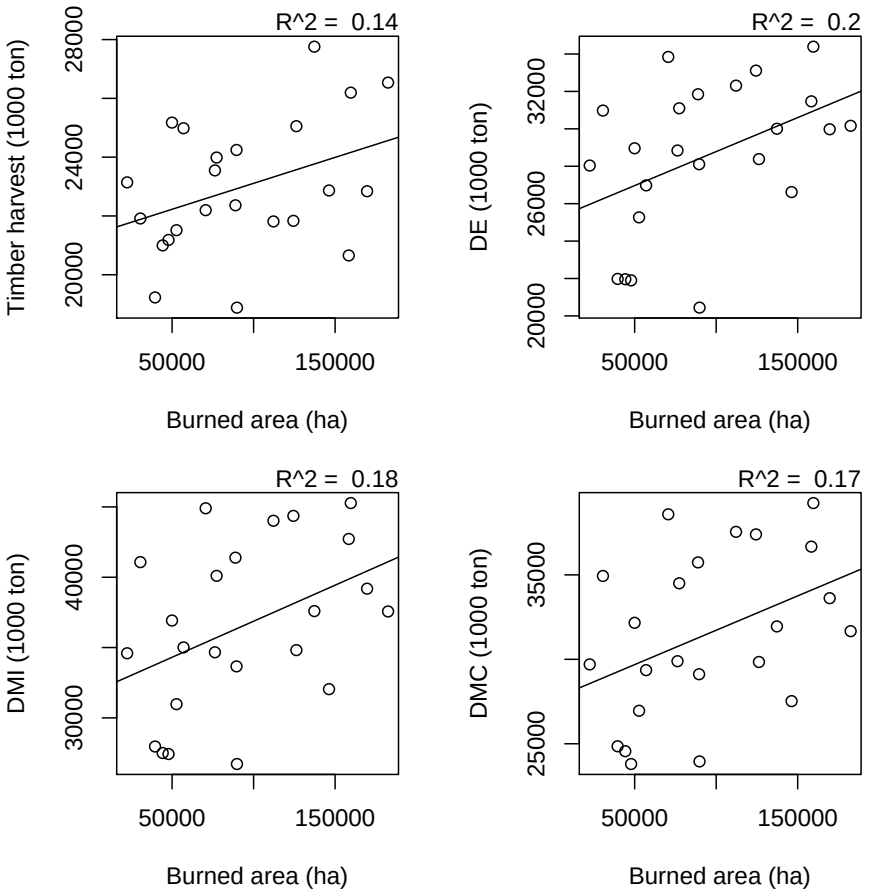


Figure 8.17: Bivariate plots between burned area and biomass material flow indicators (2003 outlier excluded).

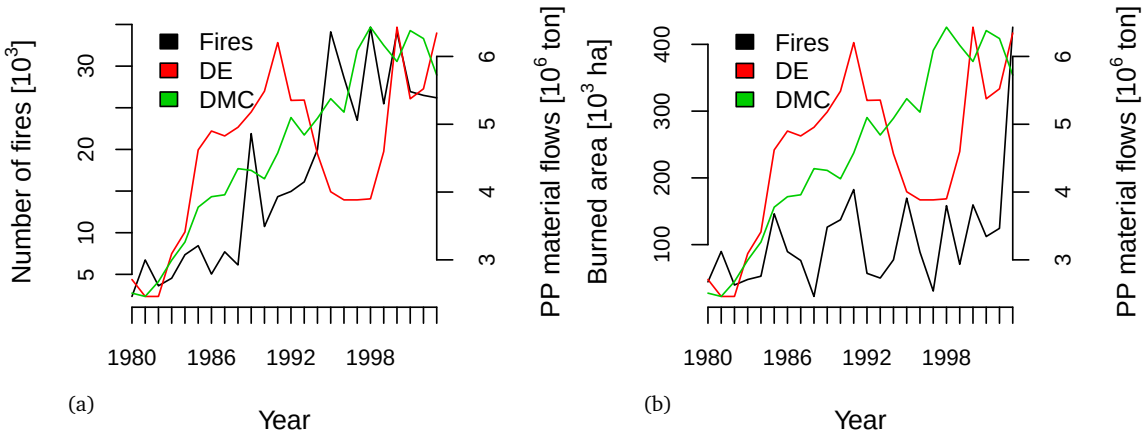


Figure 8.18: Evolution of number and area of fires in contrast to DE and DMC of the pulp sector.

Moving to the ILA, parallel representations should be able to check for congruence between:

1. the wood market and forest fires
2. land use changes and forest fires

On both cases, EV1 will be land in forestry, since I want to look specifically at the evolution of forest areas. For EV2, the decision rests on the narratives to look at. Domestic extraction of pulpwood in contrast to domestic material consumption of pulpwood, are represented in 8.19(a) and provide insights on the role of these material flows on ecological, economical and even conflict related aspects (as was suggested by the previous correlations). Added value of the national pulp and paper industry comes in representation 8.19(b). Representation 8.19(c) relates the burned areas with land use. Actually, burned areas are used both as a fund (in 8.19(b)) and as a flow (in 8.19(c)).

From the representations, it is possible to confirm the strong entailment of domestic extraction with the incidence of fires. What is more interesting is that the ratio of DE/DMC given by IV2 in representation 8.19(a), is proportional to the burned forest land ratio, given by IV3 in 8.19(c). This entailment is also visible when looking from the reverse direction: DE/DMC is higher in the year when proportionally more forest burns. Representation 8.19(b) shows that the trend of added value of the industry is related with that of burned areas.

8.8 Environmental load displacement (P7)

Several authors (Dalby, 2002a; Barnett, 2003) relate environmental conflicts with high levels of resource consumption and their global geographic differences. I attempt to relate the worldwide and geographically uneven increase in the global paper consumption with the expansion of eucalyptus plantations in Portugal - and, more specifically with the related conflicts. My hypothesis is that paper consumption and environmental

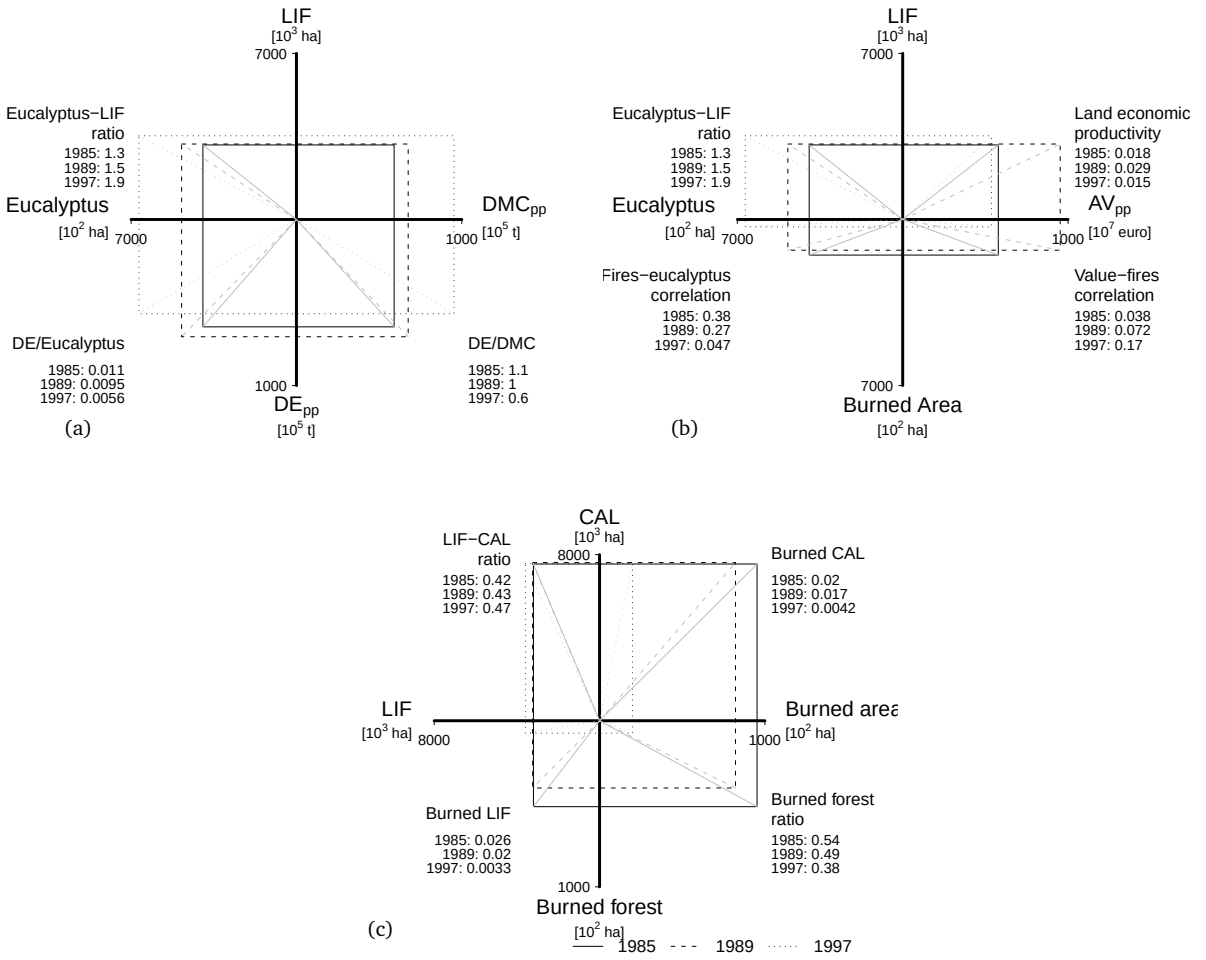


Figure 8.19: Impredicative loop analysis for the fire pathway (P6)

load displacement have an hypercyclic behavior, due to the reduction of costs brought by the displacement.

With a focus on production, figure 8.20 shows the physical trade balance (PTB) of the world regions for wood (pulpwood for production, industrial roundwood for PTB), pulp and paper.

Figure 8.20 shows an intensification of pulp and paper trade balances among world regions. The increasing gap between net importers and exporters grows together with an increase in production of raw materials and products, revealing a sector in true material expansion.

The EU-15 block and Asia became growing importers of pulp, while Latin America and North America raised their physical trade balance. The trends of Latin America in

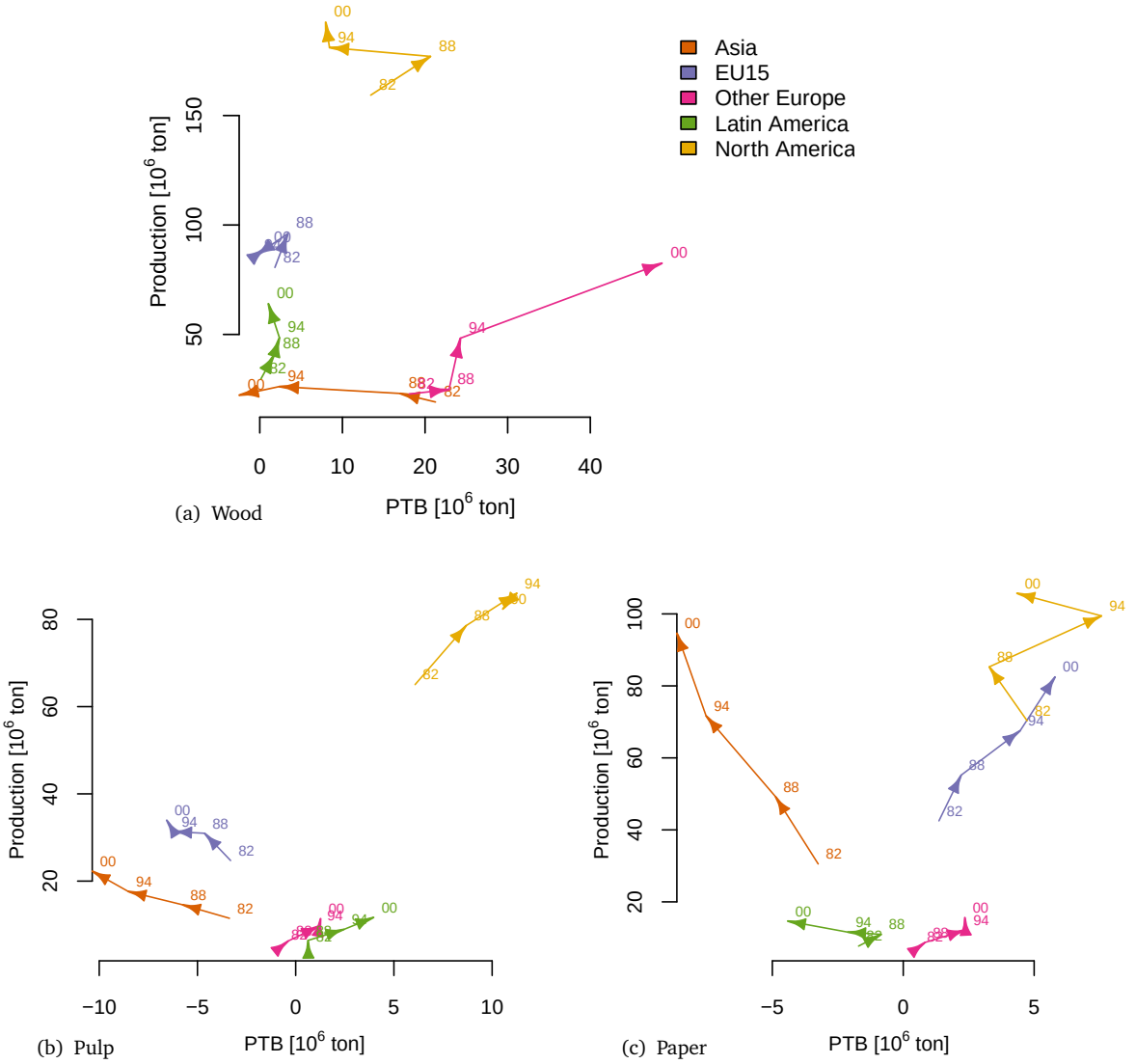


Figure 8.20: Production and physical trade balance of wood, pulp and paper for world regions (3-year moving average).

terms of wood and pulp production, suggest that there was an increased production of pulp, reducing the PTB of wood. This also appears together with the role of the "Other Europe" block of countries, which more than doubled their net exports of industrial roundwood during the 90s.

Paper shows a slightly more complex trend, but intensification of physical trade balances is also happening. Asia and North America intensify their paper net imports. Asia consumption is pushed mostly by the enormous population growth, while North America imports can be related to its growing per consumption levels until the mid 1990s (figure 8.4). EU-15 countries take over Latin America as the main exporters of

paper

The results presented on paper consumption, production and physical trade balance of wood, pulp and paper are able put in evidence the geographical differences in terms of material use of the paper industry. Higher per capita consumption levels are related with major paper industry centers - particularly the EU and North America. The EU, by importing pulp and exporting paper, is able to displace the lower level activity which has the highest environmental load, both through land (for pulpwood) and toxic emissions (from pulp production), while expanding the production of the much more valuable paper. It is interesting that this also matches the trends in the prices of pulp and paper, presented in figure 8.11: pulp prices drop to unprecedent levels in the 1990s, while paper prices reach its highest values by the middle of the decade.

Going downscale, I present in figure 8.21 a brief overview of the evolution of the EU-15 countries paper consumption. The figure makes clear the geographic differences that exist also within the EU countries concerning paper consumption. Some of the major investors of the paper industry in Europe - the Scandinavian countries, particularly Sweden and Finland - are the higher per capita consumers of paper and paperboard. Portugal appears on the other end, with the lowest value of the EU. What is the picture in terms of wood trade and pulp and paper physical trade balance?

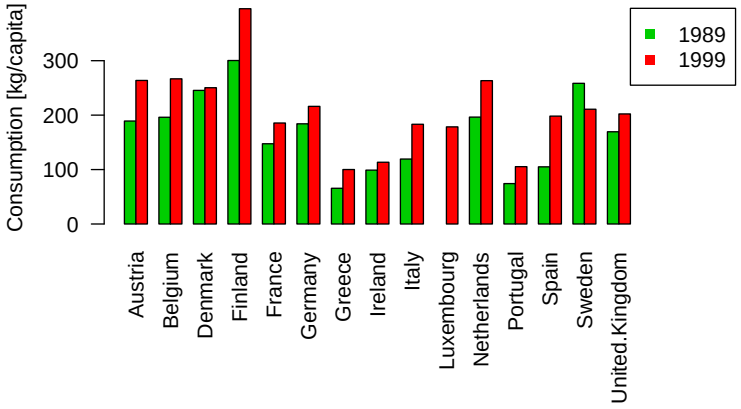


Figure 8.21: Paper consumption per capita in EU-15 countries

Looking at figure 8.22, we can see that peaks in production are linked with increased imports and, to a minor extent, to increased exports. This is possibly related

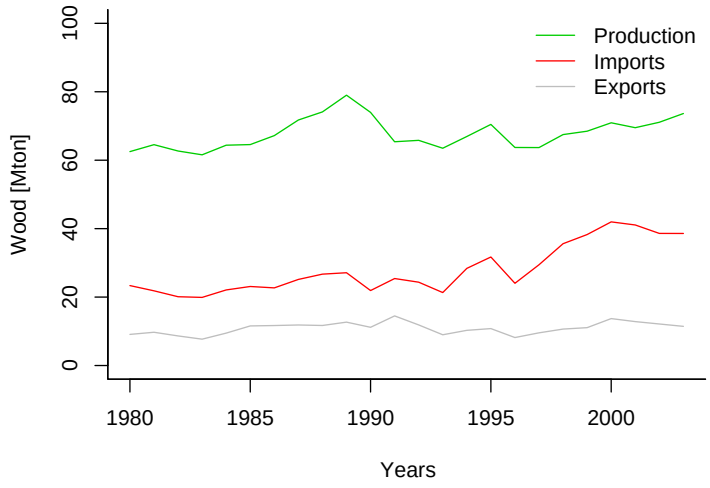


Figure 8.22: Wood production (pulpwood) and trade (industrial roundwood) in the EU15

with cycles of the pulp and paper markets, since this peaks, since 1989, are evenly distributed in periods of 5 to 6 years.

Also, it is interesting to notice that, after 1994, imports became increasingly important in the overall supply of roundwood to European Union countries. On the other hand, exports of roundwood have been kept relatively stable and low, accounting on average for 16.02% of the total pulpwood production with a standard deviation of 0.021.

Table 8.2 shows the physical trade balance evolution of all EU-15 countries. Based on the table data, a subset of EU countries was extracted. The selection criteria was based in having different patterns of trade among the major EU-15 traders:

- Austria, a net importer of pulp and exporter of paper;
- Finland, a net exporter of all paper related materials (similar to Sweden, but with stronger variations);
- Germany, a net importer of pulp and paper and exporter of roundwood;
- Italy, importer of all materials, increasing at very fast rates (similar to the UK, but

	Roundwood			Wood Pulp			Paper		
	80s	90s	var	80s	90s	var	80s	90s	var
Austria	3.76	2.55	-32%	-0.05	-2.69	4875%	10.38	19.67	89%
Bel+Lux	5.82	5.41	-7%	-2.97	-3.28	10%	-6.64	-9.74	47%
Denmark	6.19	2.43	-61%	-0.55	-0.20	-64%	-6.32	-8.73	38%
Finland	11.17	5.75	-49%	15.56	14.05	-10%	59.33	89.21	50%
France	21.17	11.22	-47%	-14.34	-16.25	13%	-12.52	-11.70	-7%
Germany	3.77	11.05	193%	-29.18	-35.44	21%	-18.44	-16.68	-10%
Greece	-1.34	-0.80	-41%	-1.36	-1.19	-13%	-2.02	-3.64	81%
Ireland	2.02	1.77	-12%	-0.13	-0.23	79%	-2.44	-3.82	56%
Italy	-17.82	-27.51	54%	-17.47	-27.38	57%	-6.64	-15.43	132%
Netherlands	-1.88	-5.45	191%	-5.64	-7.23	28%	-4.36	-4.22	-3%
Portugal	4.08	4.83	19%	7.17	9.65	35%	0.68	0.85	24%
Spain	-2.16	-2.58	20%	0.15	1.37	814%	-2.21	-16.78	659%
Sweden	6.85	9.46	38%	28.71	25.87	-10%	51.06	70.80	39%
UK	-13.85	-17.98	30%	-18.09	-18.95	5%	-40.85	-48.98	20%

Table 8.2: Physical trade balance evolution (10-year sum) of EU-15 countries for paper related materials.

with stronger variations);

- Portugal, a net exporter of all paper related materials. Unlike Finland and Sweden, PTB is higher for pulp than paper;
- Spain, a net exporter of pulp, becoming a major importer of pulp in the 1990s.

Figures 8.23 and 8.24 show the physical trade balance for pulp and paper, respectively. One immediate observation is that trade balances of both pulp and paper have been significantly amplified from the 1980s to the 1990s. As was observed in terms of world regions, there is also an intensification of the physical trade balance of EU-15 countries.

Among the pulp exporters we find Finland and Sweden on top. Portugal comes as the third major exporter of pulp during the two decades. However, while Sweden

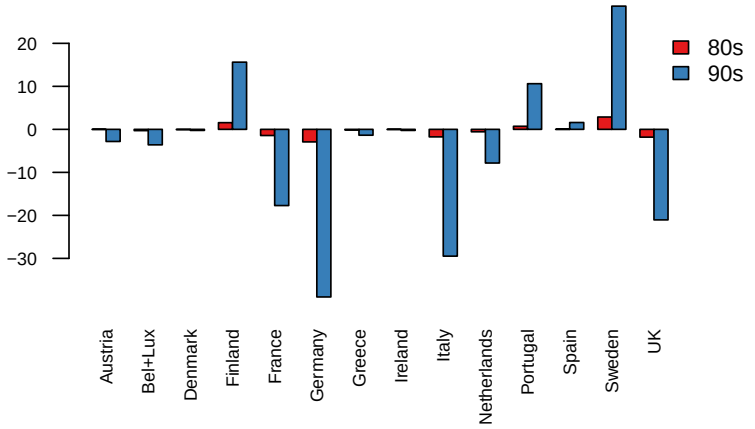


Figure 8.23: Physical Trade Balance (PTB) of pulp for EU-15 countries (10-year sum).

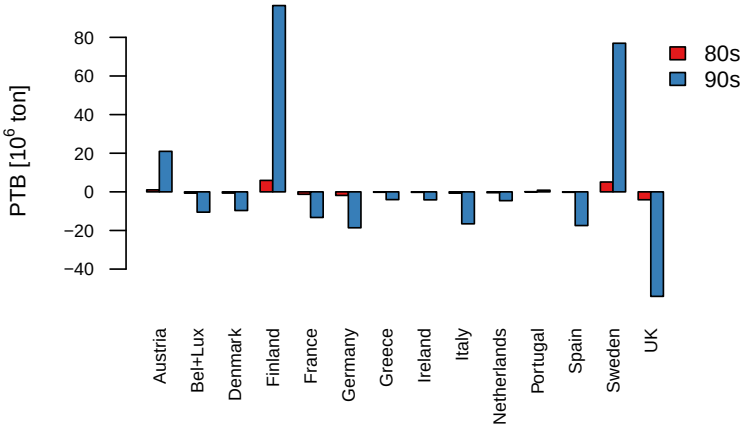


Figure 8.24: Physical Trade Balance (PTB) of paper for EU-15 countries (10-year sum).

and Finland are also net exporters of paper, Portugal has a relatively null physical trade balance regarding paper. In fact, Sweden and Finland show a substantial increase of paper exports from the 1980s to the 1990s.

On the bottom, as net importers of pulp, appear Germany, Italy, UK and France. All of them are net importers of paper as well. However, Germany shows a smaller negative balance than that of pulp, meaning that it is actually transforming a big part of its pulp imports. Austria also appears as a net importer of pulp, but net exporter of paper.

Figure 8.25 gives additional insights, by bringing together production and physical trade balance. Germany and Italy are net importers of pulp and paper, despite being

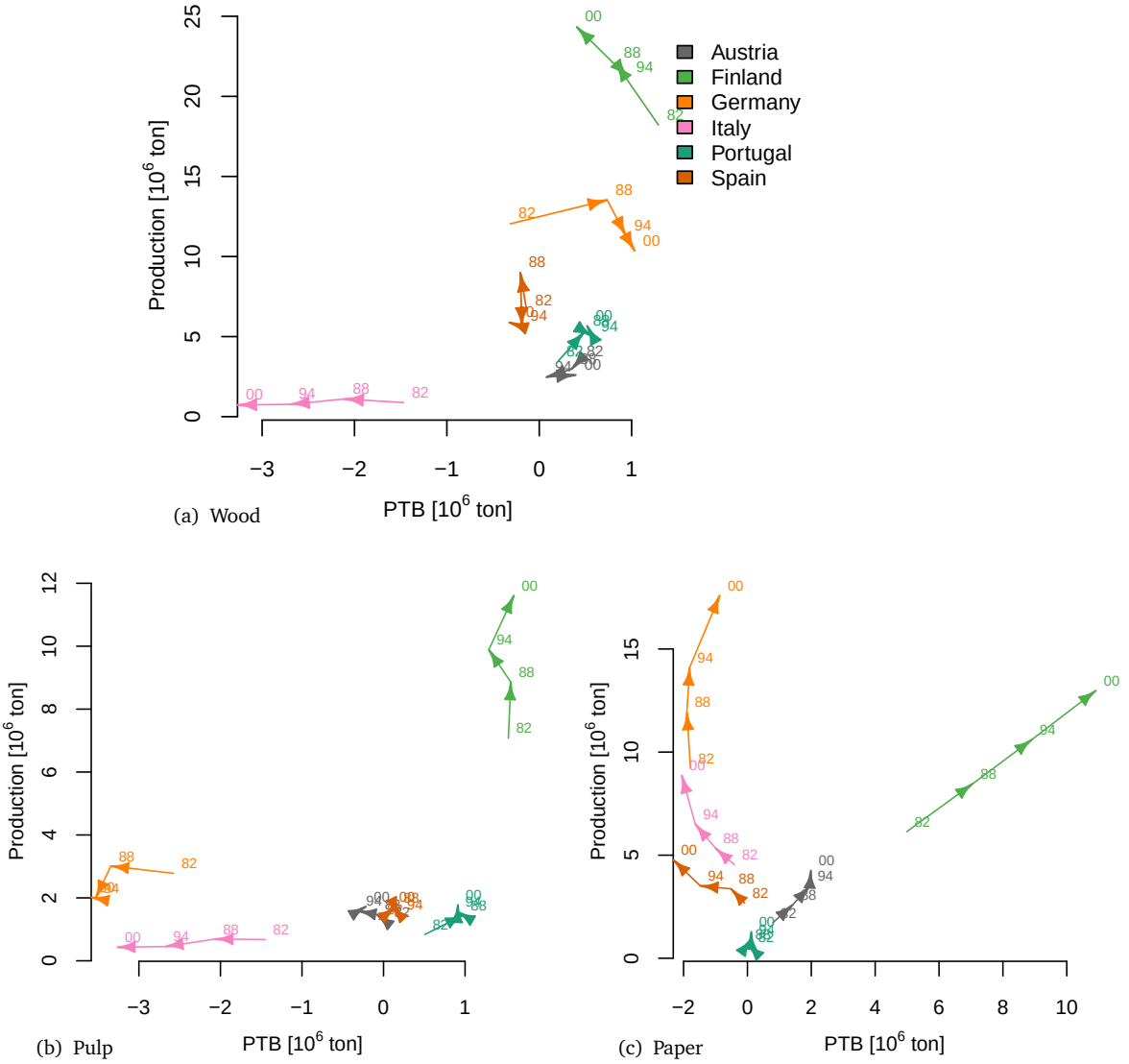


Figure 8.25: Production and physical trade balance of wood, pulp and paper for EU-15 countries (3-year moving average).

major producers of paper. Austria is the second biggest paper exporter. In face of the low production and imports of pulp, this suggests that supply to their paper industry is achieved through high levels of paper recycling. Scandinavian countries, despite being net exporters of pulp, have to a much larger extent become exporters of paper. These countries can be considered to form the core of the EU-15 paper industry.

Portugal and, to a lower extent, Spain, can be characterized as peripheries. The physical trade balances of pulp are positive and significative in relation to the total production. At the same time, paper production is low.

Moving down one further level, how are these large scale dynamics of pulp and paper trade and consumption projecting into the Portuguese system? Figure 8.26 contrasts the evolution of average export paper prices with the EU-15 consumption levels. A near 12-year cycle seems to exist in the paper prices. It is also pretty evident from the figure that paper consumption in the EU is strongly (negatively) correlated with the price: periods of higher growth in consumption are linked with decreasing prices. An interesting aspect is that they are not related with low prices, but rather with declining prices.

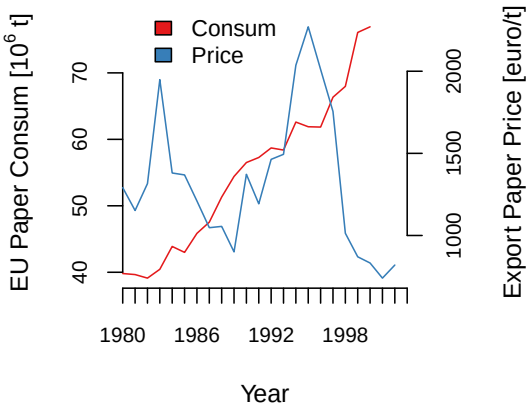


Figure 8.26: Evolution of paper prices in contrast to the EU-15 paper consumption

8.9 Ecologically unequal exchange (P8)

The last pathway focuses on understanding the geographical differences of consumption and production at the material level. Several authors (Hornborg, 1998; Muradian & Martinez-Alier, 2001; Martinez-Alier, 2004c), have attempted to describe the phenomenon of ecologically unequal exchange. Besides appearing connected with an environmental load displacement, ecologically unequal exchange can also be related to the terms of trade between countries and regions.

In continuation of the previous pathway on environmental load displacement, the analysis of terms of trade that is made here attempts to understand the existence of hypercycles of deterioration of terms of trade. These hypercycles can appear at any point in the holarchy, from world regions, to country regions or even households. I

argue that a decline of terms of trade at any holarchic level, can propagate across scales. This in turn develops feelings of social unjustice, leading to an environmentalism of the poor discourse and to conflict. To be able to formalize this I propose an evolutionary analysis of the terms of trade of wood, pulp and paper.

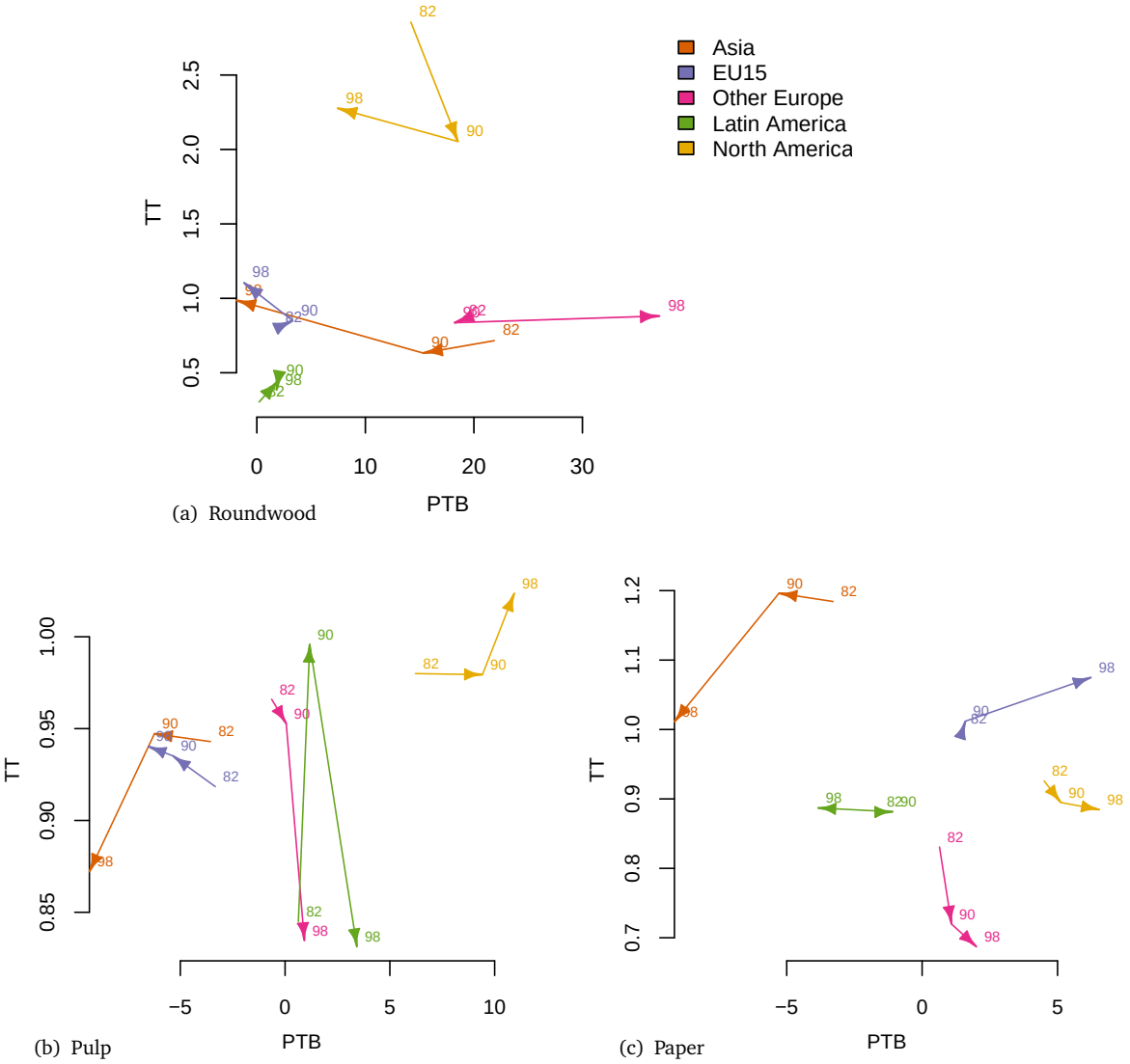
In order to understand the full picture in regard to the terms of trade of the pulp and paper industry, it is important to consider the whole cycle of tradeable goods, from the raw materials to the final consumer product. Rather than developing an aggregated index, I propose to look in parallel at the representations for (round)wood, pulp and paper.

I start the analysis by looking at the terms of trade and physical trade balance of world regions between 1980 and 2000 (figure 8.27). This gives an overview of the regions placements in the paper industry world system.

Figure 8.27(a) shows for the 1980s decade a major decline in the terms of trade of North America, a reduction of PTB of Asia and a slight increase in the terms of trade of the EU-15. During the 1990s, some regions follow different trends. All regions except Latin America and Other Europe increase their terms of trade. As was previously mentioned, Other Europe becomes the biggest net exporter of roundwood, while Asia continues to reduce its PTB, to the point that it comes from a position of the largest net exporter of roundwood, to the bringe of becoming a net importer.

Figure 8.27(b) provides very interesting insights in the pulp terms of trade. For the 1980s decade it is possible to observe a major increase of TT for Latin America, together with a slight increase in the PTB.

During the 1990s, the PTB trends are maintained, but the direction of the terms of trade change for all regions. There is a notable decline of the terms of trade of non-EU-15 European countries, a probable consequence of the fall of the East-Soviet block. Also, Latin America reverts its terms of trade to a level lower than that at the beginning of the 1980s. It is plausible that this change benefited the pulp terms of trade of EU-15 countries and North America, allowing for growing cheap imports. Asia also reduced its terms of trade.



(a) Roundwood

(b) Pulp

(c) Paper

Figure 8.27: Evolution of terms of trade (TT) and physical trade balance (PTB) of world regions.

Figure 8.27(c) reveals yet a different pattern of terms of trade, this one for paper. The 1980s show a sharp decline in the terms of trade of all regions except EU-15, which remains stable. There are few variations in the PTB, except for Asia with its ever increasing imports.

During the 1990s, several changes in the paper international market happen. The most relevant change is the increase in the PTB of EU-15, which catches North America as a net exporter of paper. However, while EU-15 increases their terms of trade, North America seems to fall behind. Latin America became a net importer of paper, a position shared with Asia. The increase in the terms of trade of paper for the net exporter EU-

15, might be related to an increase in the demand of Asia, which goes together with a deterioration of the regions terms of trade.

A paralell observation of the three representations suggests that the world paper market went through a strong restructuring and relocation around the turn of the decade of 1990. EU-15 becomes the center of the paper industry, as a net importer of pulp and net exporter of paper at increasingly favorable terms of trade. Latin America, being highly dependent on pulp exports, seems to suffer from the price fluctuations of this resource.

The high demand of paper of Asia seems to also benefit the exporting regions. The effect is not visible in 1990, a possible consequence of the cheap exports provided by the Other Europe region. However, by 2000, both North America and the EU increase their paper terms of trade. This happens despite the increase in exports of the three paper exporting regions, which suggests that world demand is pushing the production of paper. North America and the EU are able to also improve their pulp terms of trade.

Navigating to the EU-15 holon, figure 8.28 shows the terms of trade and physical trade balance for a subset of EU-15 countries.

The EU countries terms of trade evolution show some similarities with the changes observed for the world regions. One clear development at both scales is the increase of external dependency of net pulp importers, while net exporters tend to intensify their exports. In the 80s decade, terms of trade decline, but this situation is inverted by 2000. Within the group of six selected countries of the EU, Portugal, Sweden and Finland appear as net exporters of all the materials, while Italy and the UK are net importers. Germany is overall an importer, but after 1990 it became a net exporter of roundwood, possibly as a result of the fall of the Wall and the merge with the German Democratic Republic.

Representations 8.28(b) and 8.28(c), depicting pulp and paper, reveal that the lower the physical trade balance of the country, the highest are its terms of trade for the product. With the exception of Finland, this pattern is more clear during the 1980s. During the 1990s, the gap in terms of trade was shortened for both pulp and paper.

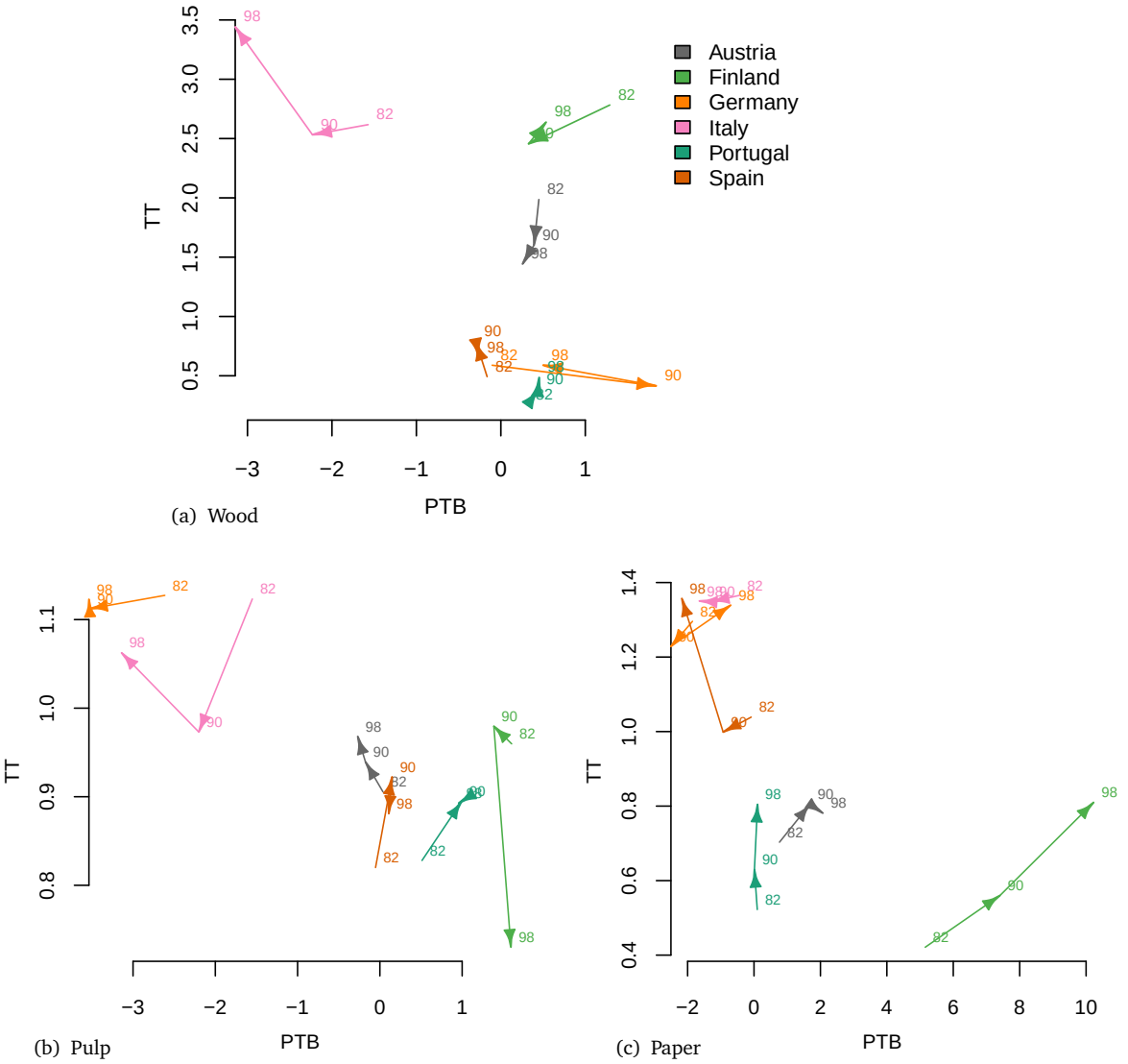


Figure 8.28: Evolution of terms of trade (TT) and physical trade balance (PTB) of EU-15 countries (5-year averaged).

The only exception is Finland, which has declining terms of trade for pulp. However, overall this is compensated by the much larger improvement of the terms of trade for paper. Representation 8.28 also shows that Portugal has a slight increase in physical trade balance of pulp (due to increasing pulp exports).

The previous representations have one disadvantage: they do not give an indication of the relative ecological pressure of trade. The differences in the size of EU countries, represented in figure 8.28 make it harder to understand their relative terms of trade from an ecological perspective. Figure 8.29 provides a slightly distinct perspective. By dividing the physical trade balance by the land area (TAL) of the countries, it

attempts to provide a better indication of the environmental pressures of wood, pulp and paper trade.

While the patterns of change remain the same (land area is constant over time), the relative positions of some countries are changed. The physical trade balance of roundwood and pulp per unit of land is higher for Portugal than for Scandinavian countries. Even though Scandinavian countries are net exporters of wood, pulp and paper, the resource use intensity of the pulp and paper sector is much lower than that of Portugal.

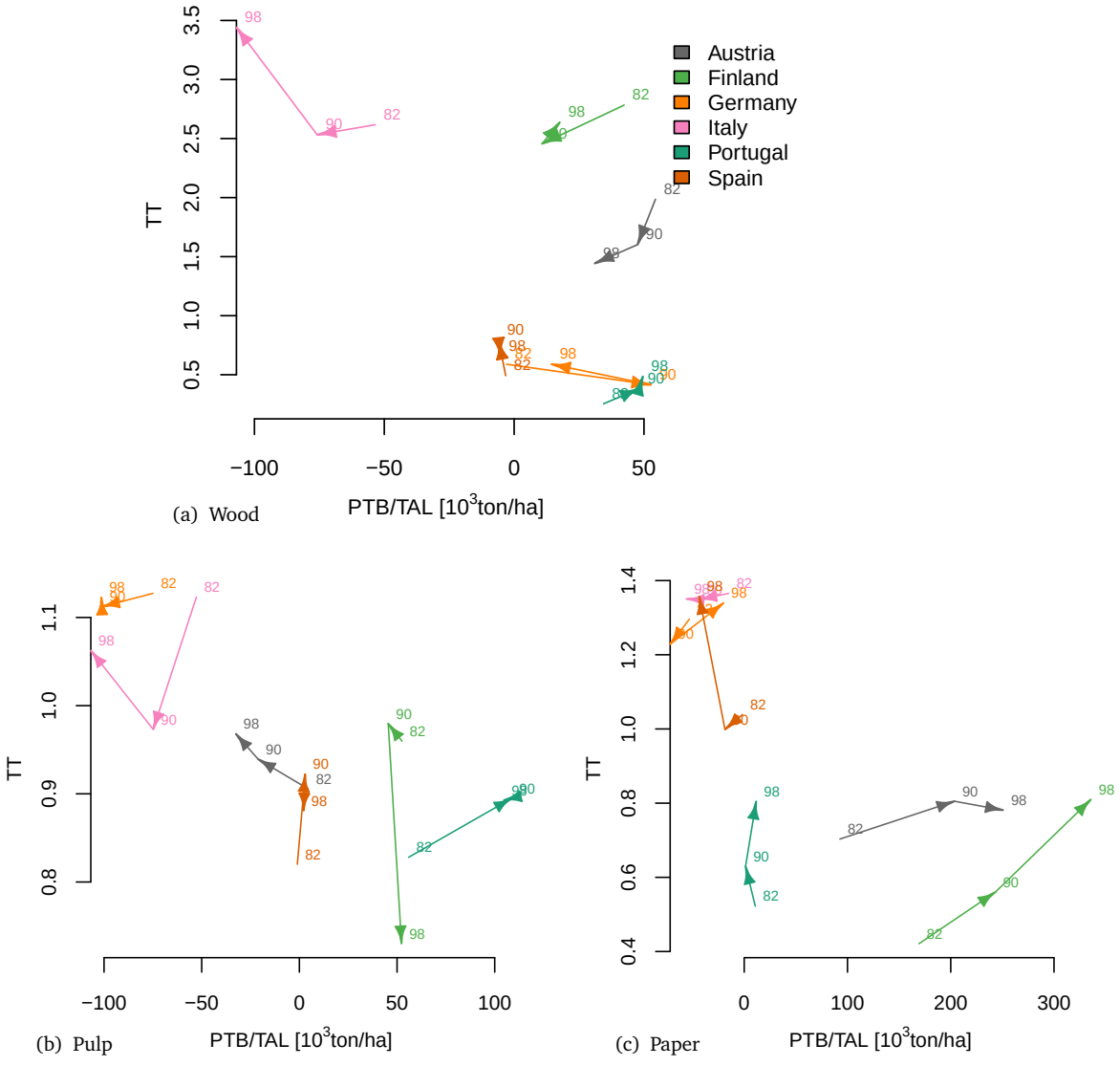


Figure 8.29: Evolution of terms of trade (TT) and physical trade balance (PTB) per unit land of EU countries (5-year averaged).

Additional information might be given by zooming in to the period around the turn

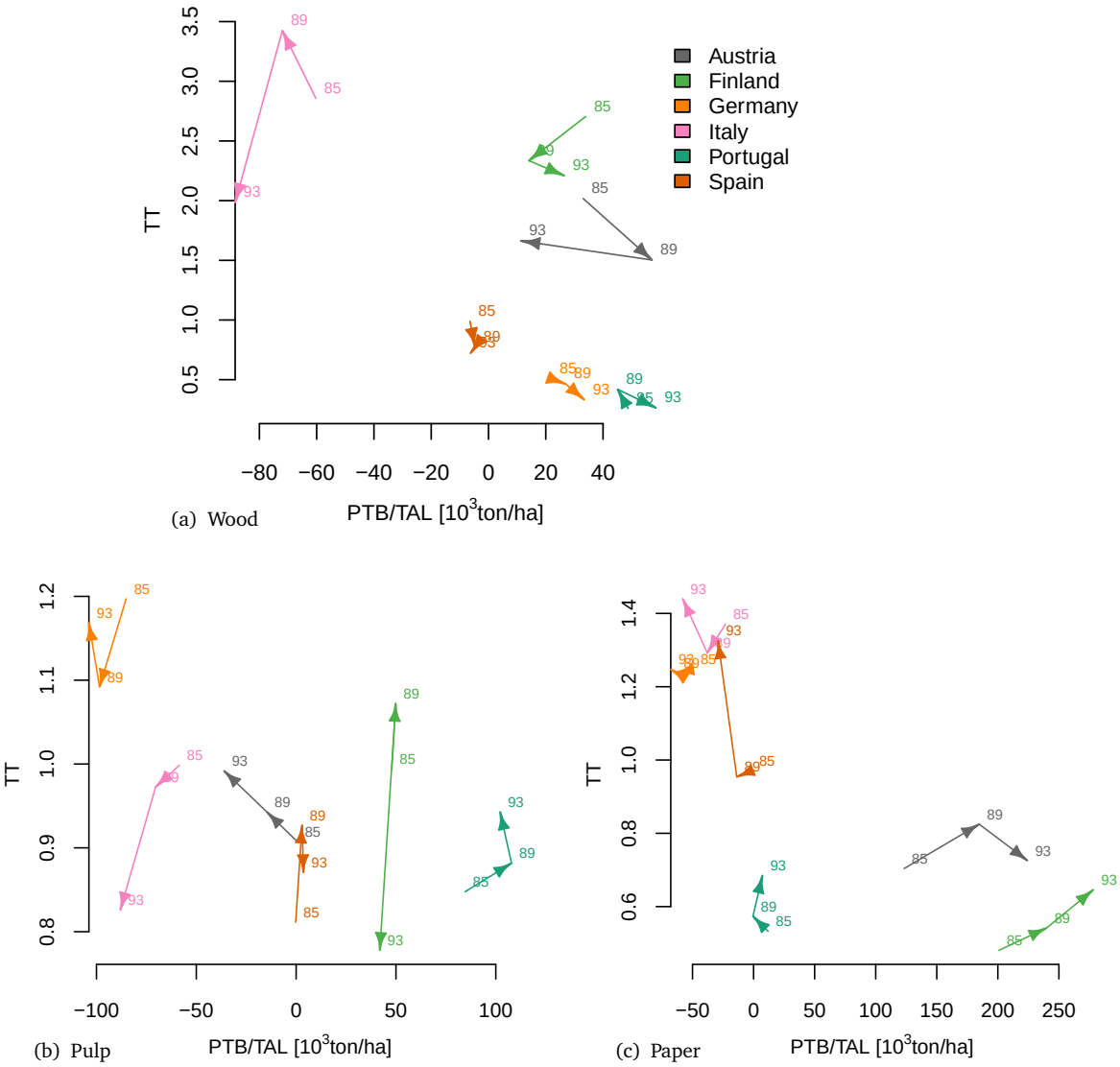


Figure 8.30: Evolution of terms of trade (TT) and physical trade balance (PTB) per unit land of EU countries between 1985 and 1993 (3-year averaged).

of the decade, to figure 8.30. From the analysis of figure 8.30, we can see that around 1989, the period with most intense conflicts, Portugal is increasing its net export of pulp, while having the lowest terms of trade of all countries and for all materials (only Finland has similar terms of trade for paper). Portugal is the country with the highest environmental pressure related to the production of pulp, which is particularly high around 1989, with a slight alleviation thereafter.

8.10 Capitalist market expansion (P9)

Dalby (2002a, p.76) argued that "seen as part of the processes of the expansion of modernity, political violence can be understood to be an intrinsic part of environmental change". The expansion of modernity is here related to the expansion of the capitalist market system or, in the words of Wolf (1971, p.276), to the "spread and diffusion of a particular cultural system, that of North Atlantic capitalism".

Within this context comes the expansion of what Guha (1999, p.59) calls "scientific forestry" and its associated industry of pulp and paper production. This expansion of the capitalist market, anchored with the expansion of industrial forestry, might have pushed away populations with an high dependency on their natural environment (due to the requirement of land to reproduce their metabolism, sourced on the agricultural activity) and lacking other entitlement opportunities.

The expansion of the capitalist market might be visible as transformations in the following aspects:

- the social metabolism of the country, represented as energy, materials, time and land uses;
- the GDP and added value of the pulp and paper sector, which are part of the economicist and industrialist narratives, under the capitalist descriptive domain;
- the availability of land for agriculture, particularly in respect to the rural and peasants identity narratives

To achieve this, I select the dates for the impredicative loop analysis from the observation of figure 8.31, on the evolution of the national GDP in comparison to the added value of the pulp and paper industry. The selected dates (1984, 1989 and 1996) correspond to a period of degrowth of GDP, the conflict period (corresponding to a maximum of the pulp and paper added value) and a period where pulp and paper decrease its value, opposite to the growth of GDP.

An overview of the six representations in figure 8.32 shows that the squares

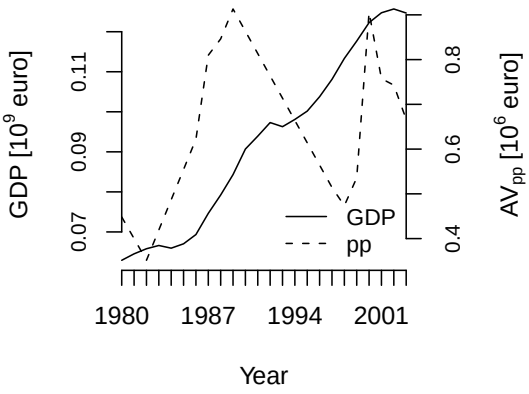


Figure 8.31: Evolution of Portuguese GDP and added value of the pulp and paper industry.

expand mostly towards the right, without significative changes in the other dimensions. This means that throughout the analysed period, there was an intensification of the use of land and work, at the expense of increased energy and material use. However, the increase in dimension of the compartments appears to be stronger until 1989 (please note that the gap between the analysed periods is distinct).

Representation 8.32(d) shows that the increase in exosomatic energy use played a very determinant role in the "intensification" of labour. This effect can be measured through the exosomatic metabolic rate (EMR), which increases both for agriculture and for the overall of the productive compartments of the Portuguese society.

Representation 8.32(d) further shows that the paid work hours lost in the agriculture sector were effectively lost and not transfered to other activities. There is a slight increase in the paid work hours in 1989, but this follows an increase in population that is given by THA in representation 8.32(c). However, until 1989 the agriculture sector is already in sharp decline in terms of labour, so it should be safe to state that people working in agriculture were at least partially absorbed by other occupations. After 1989, the increase in the exosomatic metabolic rate is effectively related to a reduction of working hours at the societal level.

This reduction of working time is tightly related with the increase in leisure time represented in 8.32(c). This apparently very slight increase in leisure time is actually pushing the household use of energy very strongly. In 12 years, the use of energy in the

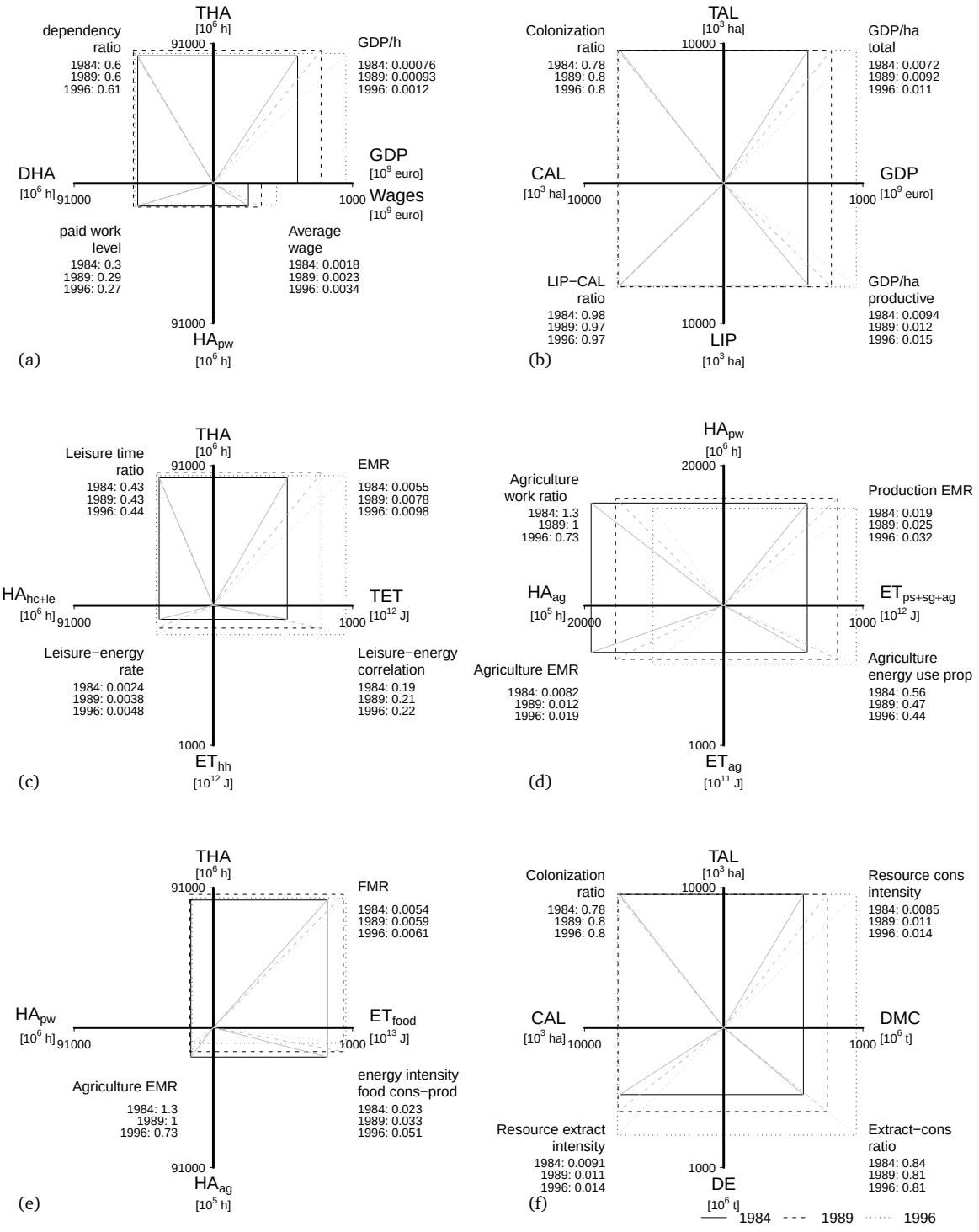


Figure 8.32: Impredicative loop analysis for the capitalist expansion pathway (P9)

household per leisure hour has doubled, while the proportion of household energy use compared with the TET has slowly increased.

Looking at another representation, 8.32(e), it is possible to observe an increase in the flows of endosomatic energy. This means that people eat more in terms of energy (more joules or calories), as can be seen by the values of the food metabolic rate (FMR).

Wages increase (8.32(a), but by 1989 they fall behind the pace of economic growth, only to partially recover later.

The parallel observation of these representations on the energy and labour domains, reveal that the increasing flows of exosomatic energy are not exclusively due to intensification of productive processes. On the consumption side there is also an intensification of the energy use - both exosomatic and endosomatic - meaning that the consumers identity in the Portuguese society has, in fact, changed along the 1980s and 1990s. This change was certainly supported by increases in GDP (representations 8.32(a) and 8.32(b)), allowing for more power of purchase of consumers, the intensification of their household energy use, which then is related to the use of more consumer goods (such as TV or kitchen equipments).

The demand for this is embedded in the offer provided by a more energetically and materially intensive economy. Representation 8.32(f) provides further information on this. Both the extraction and consumption of resources have increased together with the capital flows. However, the extraction-consumption ratio has decreased between 1984 and 1989, which means that consumption has increased more than extraction. This tells that the production within the country has been unable to cope with the increasing demand of its changing lifestyle and had to rely on increased imports.

Overall, this pathway has shown that an hypercycle of capitalist expansion, materialized by growing consumption of production, is supported by increasing flows of exosomatic energy and materials.

Chapter 9

Sustainability dialectics: navigating the conflict pathways

> «The ”negative“ property of dissipation shows that, unlike dynamic objects, thermodynamic objects can only be *partially* controlled. Occasionally they ”break lose“ into spontaneous change»
>
> – Ilya Prigogine and Isabelle Stengers, Order out of Chaos, p. 120

An integrated approach to the dynamics at place in the conflict situation, require relying on dialectics. In the approach proposed in this thesis, dialectics are able to generate a discussion of concepts and findings among the different analysed pathways. It is particularly important to have present, along this discussion, the storytellers' narratives under the different descriptive domains. These have formed the basis for building their identities.

Following Hegelian dialectics, an idea (thesis) is presented together with its opposite (antithesis), in order to generate a coherent synthesis. To contrast the ideas and findings of the theoretical pathways, the antithesis for each pathway are often drawn from other pathways. This dialectical effort is able to provide a critical dialogue and bridges between the different descriptive domains.

9.1 Why did conflict happen in the late 80s?

Why did conflicts take place in the specific moment in time of the late 1980s and not later, when the eucalyptus afforestations were continuing at a reasonable pace? This might be related to features of the Portuguese society that existed in the late 1980s and ceased to exist in the 1990s. On the other hand, it might be related to changes in the dynamics and configuration of the pulp and paper sector. I will first explore the dialectics related to the conflict period, before moving to the discussion of the post-conflict dynamics.

9.1.1 Population growth or increasing consumption?

The first pathways (P0 and P1) have tried to relate conflicts with the hypothesis that either a populational growth or an increasing per capita demand for paper was leading to a situation of resource scarcity.

Looking at the Portuguese population growth or even per capita consumption appears to be pretty irrelevant for understanding the scarcity of resources, be them pulp, wood or land. The pulp and paper industries are strongly embodied in the global market, so only by looking at the trend of global consumption of goods (such as paper) becomes possible to understand how resource demand grows and possibly leads to scarcity.

At the global level, the results have shown that both effects are involved in an increasing consumption of paper, but with strong geographical differences. Asia, which contributes the most to an increasing global consumption has an almost negligent per capita consumption increase. On the other hand, North America and EU-15, have substantially increased their per capita consumption of paper and pushed absolute resource consumption up.

To what extent is this increasing demand for paper, pushed by both an increasing population and consumption level, pushing resource scarcity and leading to forestry related conflicts?

The growing worldwide consumption of paper, which doubled from 1980 (169 million tons) to 2000 (326 million tons) moves together with an expansion of fast growth paper pulp plantations, particularly eucalyptus. Was this leading to some kind of resource scarcity around the conflict period?

The ILA in 8.6 reveals that, after 1989, the consumption of the pulp and paper sector surpassed the internal supply of pulpwood. This happened immediately after the resource extraction intensity reaching its top level by 1989.

The increase of extraction intensity until 1989 (figure 8.6(a)) and peaking wood prices (figure 8.11) signals a growing resource scarcity situation, driven by an increased consumption of the sector, which in turn was motivated by the installation of the Figueira da Foz pulp mill. The particular intensification up to 1985 is a clear signal that the entrance in operation of the Figueira da Foz pulp mill was a central factor in generating a demand induced resource scarcity of pulpwood, which promoted a race to lands for afforestation.

In the 1990s, when the conflicts against eucalyptus became silent in Portugal, resource extraction intensity dropped again. These results suggest that resource scarcity, from the viewpoint of the industry (i.e. pulpwood as resource), is somehow related to the conflicts.

The production of paper in Portugal doubled by the end of the century and the area of eucalyptus plantations in Portugal continued to increase (to the point that it is becoming the tree with the biggest area, surpassing the pine and the cork oak).

On the other hand, from the perspective of the rural or peasant identities a resource scarcity situation does not seem to have occured at the macro level, even during the conflict period. In particular, within the land use descriptive domain, no significant reductions of land in agriculture took place despite the growth of eucalyptus area (figure 8.9) and in the food security descriptive domain, food production was actually increasing in face of productivity increases (figure 8.14).

9.1.2 Colonization or land grabbing?

Regarding land use, the analysis suggest a low influence on the evolution of land in agriculture (LIA) exerted by the expanding land in forestry (LIF), particularly pushed forward by eucalyptus afforestations. LIF seems to have been pushing forward land in production (LIP), which sums up LIA and LIF, therefore expanding the frontiers of colonized land (figure 8.12(b) and reducing the space for the provisioning of ecosystem services.

Figure 8.10 gives a distinct view on the evolution of LIA, by looking at the sub-compartment level. In particular, it shows a substantial reduction of arable land, which happens to be the type of agricultural land that requires more work. However, LIA is not reduced because there is a major growth in pasture land. Salgueiro (2008) confirms that this growth in pasture area is probably a substitution of lands for cereal production and fallow lands, both part of the arable land category. But why is pasture land increasing, if there is, in fact, a reduction of livestock numbers and an increase in processed feeds, while forage crops maintain relatively the same area (according to Salgueiro, 2008)? Salgueiro (2008) justifies this with productivity increases, which lead to an increasing amount of food taken by the animals. The author points out the example of milk cows, that have increased total production despite reduction of numbers, due to genetic improvements. On the other hand, he considers that there is an underuse of the pasture resources for animal feed.

I find both factors pointed by Salgueiro (2008) to be an insufficient and simplist justification to the huge increase of pasture areas. In fact, looking at the evolution of some of the analysed variables, such as the IV intensity of extraction from agriculture (IV3 from representation 8.9(d)) there is no indication of an underuse. The lowest IV3 value was in 1993 and after this period it remained relatively stable. There is, of course, the possibility that arable land productivity would increase to the extent that it compensates the underuse of pasture lands. However, in the situation of decreasing arable lands, this would require increases in food production in an order of greatness much bigger than that which is revealed in 8.14(a). Food production increases between 1988 and 1991, but not between 1991 and 1999, which is the period where the highest

reduction of arable land takes place.

Resource capture or, more specifically, land grabbing, through the conversion of non-pasture livestock feeding land (either classified as forest land or non-colonized land) to forestry uses, particularly eucalyptus, becomes a plausible hypothesis in face of the previously pointed results. This appears as a more complex form of scarcity, resulting from a set of structural aspects (see Homer-Dixon, 1999). My supposition derives from the faster growth of eucalyptus area than land in forestry (given by the IV3 in representation 8.9(b)) together with the empirical observations in the field study of Aboboreira. Forest areas in mountains might have an open access, even when the property is clearly defined as private. This customary right, called “montes livres” allows private land to be used for pasture when the land is not being used for crops. If this happened, as representation 8.9(b) might suggest, then there have been cases where a rivalrous and nonexcludable resource - land in forestry with other non-wood uses, such as grazing - became a rivalrous and excludable resource. Homer-Dixon (1999, p.48) points out that “structural scarcities arise primarily with resources that are *excludable*, which means that property rights or other institutions can be used to prevent access to the resource by some actors”. ”Resource capture“ by the powerful pulp and paper industry might have happened with this change.

In fact, this phenomenon of ”ecological marginalization“ of peasants did take place in Aboboreira. The 30 ha of eucalyptus that ended up being planted, effectively took away the non-exclusive use of the *montes livres* for animal grazing. It would be interesting to know what classification has been given to this land - and other areas customarily defined as *montes livres* - previous to the afforestation with eucalyptus.

Further evidence on land grabbing was provided by comments from interviewed specialists from the pulp industry. Land grabbing strategies have included deceptive or misleading negotiation efforts, by sending agents to target individuals in the community with the aim of downplaying land prices. In the understanding of this specialist, the industry use of these strategies was highly responsible for increasing grievances in the rural world against eucalyptus and the pulp industry. These strategies have been progressively abandonned in the late 80s, due to the damaging effect they were having

on the industry public image.

The land race for eucalyptus that seems to have taken place in the late 1980s and reduced thereafter is supported by IV3 from 8.9(a). The variable value generated per area unit of eucalyptus plantations was increasing until 1989, but decreasing again in the 1990s. This is probably related to the fact that many lands that were afforested with eucalyptus, did not succeed in having an economically viable production (as some ecologists were warning in the 1980s, regarding areas with low rainfall) and were consequently abandonned.

9.1.3 Fires: resource capture or social conflict?

An expansion of the pulp production potential has increased the demand for pulpwood and, in the late 1980s, there was scarcity of pulpwood, for the reasons discussed before. New eucalyptus plantations take at least 10 to 15 years before timber becomes available. This makes up a slow cycle, even slower if the pulpwood production comes from pine plantations. Fires, on the other hand, are an element that can bring the system into a fast phase.

In terms of adaptive complex systems, fire represents a discontinuous change which might affect the reproduction of the autocatalytic loops in place. Within the Panarchy framework of Holling (1986), such events are represented by the creative destruction phase. After this phase comes a renewal phase that will bring the system into a new equilibrium. Projecting this into the land market means that new land uses can emerge. Such emergence cannot be decoupled both from the effect of the devalued resources and the effect of the new market trends in terms of cash opportunities. It is under this complex emergence process that signals a post-fire renewal phase that such fires can be bringing an irreversible change into the system dynamics. The change is one which opens space for an expansion of economic interests over disrupted local land use and power dynamics. Within the particular analysis, this could mean an availability of wood and land at a much faster rate than that of the wood cutting cycle or of the land market demand-offer dynamics.

The outstanding case of Portugal in terms of fires is certainly beyond ecological deterministic aspects and should be related with socioeconomical and cultural phenomena. Several accusations were pushed towards the pulp industry, for their role and interest in burning the rural lands. One was exposing their interest in devaluing or clearing land to allow eucalyptus afforestations, while the other stated that burning forests was a strategy to allow buying wood at cheaper prices.

What effect had rural fires on the dynamics of the wood market? Fires result in a loss of wood in the long term, but bring a temporary increase in the wood available to enter the production process. This is supported by the similar trend of domestic extraction of the pulp sector and the burned areas in the 1980s (figure 8.18. Burned wood has only two possible uses: the production of conglomerates and the manufacturing of pulp for Kraft paper. The fact that burned wood has such small use possibilities reduces the competition of other uses, possibly leading to an increased availability of cheap pulpwood.

It could be that the major growth of the industry between 1985 and 1989, has been supported by a supply of cheap wood, that would otherwise not have happened. The trend of added value of the industry appears slightly related with that of burned areas (figure 8.19(b). However, the idea that burning forests was allowing pulpwood prices to go down is not supported by the pulpwood prices evolution shown in figure 8.11. On the other hand, high pulp export prices might have supported an increased added value of the sector in the late 1980s, which pushed the need for resources. An high demand, could have been responsible for prices staying high, while the availability of burned wood might have provided enough resources to comply with the temporary scarcity.

Figure 8.18 and the ILA in figure 8.19 expose a relation between burned areas, the extraction of resources and the added value of the industry. The correlation analysis provided by table 8.1 and figures 8.16 and 8.17, bring further evidence that increased material flows created a pressure over the system which led to an imbalance. This suggests that the industry might in fact have economically benefited from fires.

The existence of a stronger correlation of material flows with the number of fires,

rather than with the burned area might have to do with the fact that the latter is more dependent on ecological factors, such as climate. Other social-ecological factors such as land use patterns and forest diversity, as well as the effectiveness of fire combat measures come into play here. Fire combat measures might relate with the decoupling of burned area from domestic extraction (figure 8.18), which is probably resulting from a decrease in the proportion of burned forest in the 1990s (figure 8.19(c)). The expansion of industrial forestry might have allowed a larger proportion of forest areas to be put under the specific fire protection measures and management of the industrial owners.

The number of rural fires, independently of their extent, can also be related to social grievance, conflicts or economical interests. They might indicate particular social-economical situations that lead people or economic agents to undertake actions of arsoning. The relevance of the growing trend in the number of forest fires can be an indication the socio-ecological system went out of equilibrium. In fact, 1989 shows a strong peak in fires, giving support to the idea that fires are an expression, or at least an indicator, of grievances and socio-ecological imbalances.

The results and discussion give support to the hypothesis that rural fires have formed an hypercycle with the expansion of the eucalyptus plantations and the growth of the pulp and paper industry. Arsoning was clearly present and it is plausible that social discomfort towards the eucalyptus expansion, together with an expansion of the pulp industry which required a continuous supply of pulpwood, have played together in this hypercycle.

9.1.4 Economic development or rural depression?

Figure 8.32 shows trends that form part of a consumption hypercycle, related to an expansion of the capitalist market: increased GDP and wages lead to a larger budget to spend on energy in the household sector. This energy use can be either through direct consumption of goods, the increasing use of these goods (equipments such as TV, kitchen accessories, etc.) or the use of transports (an average of 35% of the transports

energy use has been mapped to household, according to own calculations), allowing the use of free time at more far places, either for tourism or for shopping.

It is possible that the pulp and paper sector has been at the source of the ”take off” of the developing economy of Portugal. In the phrasing of Georgescu-Roegen (1999), the pulp and paper sector would have then created this “moment when the economy has succeeded in creating within itself the motive-power of its further growth”. If this is assumed to be the case for the pulp industry, then the take off event that it generated was, in fact, the creation of an hypercycle of capitalist expansion.

This hypercyclic expansion would be the parallel of “The Great Transformation” described by Polanyi (2001). It is when this great transformation arrives to the peripheral rural areas of Portugal, bringing modernity and an accelerated capitalism, that social conflict increases. Two clashes might emerge from this capitalist expansion.

One is the direct conflict between the economicist and industrialist narratives (related with the pulp and paper industry), with the rural and peasant narratives in what concerns food security and income for agriculture. This clash might be observed by looking in parallel at the related descriptive domains, particularly where conflicting uses exist. This is the case for the competing use of land between the economicist/industrialist and the rural/peasant identities.

The second conflict point is related with a more holistic approach to identity. The changes in the social metabolism of the country create new sets of identities - reflected through patterns of social metabolism, described as uses of energy, materials, time and land - which might be, to some degree, incompatible with the former identities (such as the rural or peasant identities). That is, if this hypercycle is at place, changes in the metabolic profile of the country should be observed.

The first clash is one where the capitalist expansion leads to a situation of lack of entitlements for rural and peasant identities. The expansion of the capitalist market, anchored with the expansion of industrial forestry, might have pushed away populations with an high dependency on their natural environment (due to the requirement of land to reproduce their metabolism, sourced on the agricultural activity) and lacking other

entitlement opportunities.

Representation 8.32(c) shows that GDP per unit productive land has increased very significantly in Portugal. Except for the period after the entrance in the EEC, agriculture economic productivity went in the completely opposite direction, as is shown in representations 8.9(c) and 8.12(b). Resource extraction intensity did increase in agriculture (representation 8.6(a)), but at a much lower rate (25% increase between 1982 and 1996) than the extraction intensity at the societal level (54% between 1984 and 1996).

A new model of agriculture, more based on exosomatic energy inputs, came to existance during the 1980's. Capital has flown away from both the agricultural activity, and within the sector, away from payment of human labour, probably to pay for the increased exosomatic energy use. However, even though agriculture had a process of intensification, this comparison shows that the agriculture activity was (and effectively is) simply unable to cope with the pace of (economic) expansion of the capitalist market system and its related lifestyles.

Value per unit produced is lost as a result of intensification. The corollary is that to be able to survive in a society with ever increasing power of purchase, the farmer needs to constantly increase its land productivity (or resource extraction intensity) as to generate enough incoming. As Wolf (1971, p. 279) puts it, with the entrance of capitalism, peasants «had to learn how to maximize returns and how to minimize expenditures, to buy cheap and to sell dear, regardless of social obligations and social costs». This intensification hypercycle, relying on increasing flows of exosomatic energy, pushes away the possibility of survival and maintenance of a traditional peasant identity.

A reduction in human activity related to agriculture was one of the effects of modernization. Human and animal endosomatic energy was replaced by oil-derived exosomatic energy, in the form of machines and agrochemicals, leading to increases in apparent productivity.

Two aspects might be playing in enhancing the conflict potential. One is that declining employment opportunities in agriculture could be promoting social unrest on

the rural world. It is interesting to note that the study of Hespanha (1994), concluding about the relatively low dependence on land of peasants and their possibility of getting off-farm work, focuses on a nearly coastal area in the Center of Portugal (Baixo Mondego), while most conflicts have happened in inland territories, from North to South. As such, it is possible that peasants from inland Portugal might have had trouble in keeping their reproduction processes through the reliance on off-farm work in their region.

The other aspect is that farmers which remained in agriculture were less economically constrained at the end of the 1980s decade than at any other point in time, due to increases in the added value in agriculture. Some reasons can be advanced to explain the positive evolution of added value of agriculture between 88 and 91. One is that the food surplus brought by the sudden increases in productivity allowed the increase of exports. The other is that the higher penetration of agriculture in the market allowed for the commodification of food products and, therefore, to an increased accounted added value of agriculture. Additionally, funding by the Common Agricultural Policy might have temporarily pushed this value up, before the continued contraction of the activity in the 1990s.

Conflicts might as well be the result of an identitary struggle of the rural against the new emerging metabolic profile. The conflict would result from the attempt to preserve rural and peasant identities, as seen under the descriptive domains of economic capital, land use and food security. That means that either reduction of land, reduction of food or reduction of income available, pushed by a larger level resource scarcity, would play a role at generating a conflict.

A fast change in the metabolic profile, could then bring marginalization in the access to land and resources (material and capital) of the slowly changing rural identities. A larger level resource scarcity, that was happening could be projected into the agricultural activities, threatening the rural and peasant identities.

Hespanha (1994, p. 246) notes that Portuguese peasants, despite being a quite heterogeneous group, seem to have a low dependency on land as a direct source of income. A substantial part of their income, at least since the 1970 decade, seems to be supplied by non-farm work within the region. However, Hespanha (1994) points out

that there are additional motivations for the peasants attachments to land, ranging from symbolic to emotional. This symbolic value of land is particularly pronounced among older peasants, former tenants or landless workers (Hespanha, 1994, p. 246). These conclusions of Hespanha (1994) appear to suggest the existence of a "free" or "middle peasantry" (Wolf, 1971) among the Portuguese peasants. This process of "peasantry liberation" is related with the intensity of conflicts against eucalyptus.

The peasant identity seems to have been particularly threatened after 1986, when the temporary increases in the value of agriculture, together with the increase in the cost of living, have mined the reproduction of an identity based on almost circular flows of energy and small linear flows of capital. Extraction and consumption of resources were also increased together with the expanding capital flows in the Portuguese society.

From the discussion, it seems that the loss of entitlements pushed by the capitalist appropriation of land, resources and work appears related with an identitary struggle. The industrialization of agriculture might be central in this, as it appears as a double failure to the rural world: it fails to avoid a deterioration of the sector in face of the growing interest of other sectors; and it further marginalizes identities which rely on modes of production that have low dependency on exosomatic energy and generate small capital flows.

9.2 Why did conflict disappear in the 1990s?

9.2.1 Technological change or environmental load displacement?

One possible change that allowed a reduction of conflicts is that an endogenous technological change leading to efficiency increases has reduced the pressure over resources, therefore allowing a continuous growth of the industry (as proposed by the Romer-Stiglitz model, described in Homer-Dixon, 1999, p.131).

The analysis suggests that this factor is not relevant in reducing resource scarcity. Pulp and paper production efficiency do increase until 1989, but their values drop in

the 1990s (figure 8.6). A modification of the Romer-Stiglitz model by Barbier notes that increased resource scarcity could constrain innovation, particularly due to social conflicts leading to market, policy or institutional failures Homer-Dixon (1999, p.131).

The decrease of the added value of the pulp and paper industry between 1989 and 1998 (figure 8.8) could be related to the failures to superseed resource scarcity. On the other hand, this might have happened just because the industry is specialized on pulp production, and pulp prices have dropped to very low levels in the 1990s (as shown in figure 8.11).

In fact, paper production in Portugal has continued to increase in the 1990s, doubling between 1980 and 2000. This suggests that while efficency was not increasing due to endogenous technological change, innovation was not constrained by social conflict (at least at a macro sectorial analysis which puts together the pulp and paper industries).

An alternative hypothesis is that resource scarcity at the national level was avoided by relying on ”foreign land” to supply pulpwood resources. So, rather than technological change, the pressure of increased consumption could be avoided through an environmental load displacement of paper production to the new peripheries of the paper industry world system.

Nevertheless, Portugal had an increasing physical trade balance of pulp during the 1980s, meaning that it was exporting more pulp (figure 8.28), which in turn depends on the extraction of pulpwood within the Portuguese territory. Figure 8.29 shows that this environmental pressure of pulp production, measure in PTB per unit land is the highest of the EU. These values are particularly high by the end of the 80s and stabilize during the 90s. An hypothesis is that conflicts are a reaction to an expanding pressure, rather to a steady-state situation of high pressure, suggesting that there is some kind of social adaptation. Resistance might have helped to slow down the rate of expansion of eucalyptus afforestations - and therefore of the pulp sector - to an acceptable rate.

A possible explanation why strong and outreaching conflicts did not result in a relocation of afforestations and pulp production to other countries and continents (as

suggested by Carrere & Lohmann, 1996, p.87) is related to institutional strategy. In fact, the former DGF director, João Soares (personal communication) stated that the reason why Portucel did not internationalize its production in the 1990s, was because it was a public company and its activity was considered of strategic relevance for the Portuguese economy. In addition to this, EU subsidies to afforestation (through the PAF) were being injected in Portugal, in parallel with a Common Agricultural Policy that imposed limits on the agricultural activity of the country. Even though a minor part of the PAF subsidies were going to eucalyptus afforestations, the conjunction of policies suggests an intentional effort to push large amounts of the territory from agriculture to industrial forestry.

At the aggregated EU level, a displacement of the pressure over the resources to other territories is supported by several results. After 1989, the pulp and paper industry DMC increases without being supported by an equally increasing DE (figure 8.6(a)). This suggests that during the 1990s, the pulp industry faced resource shortages at the national level, which possibly led to a larger reliance on wood imports (figure 8.22). EU trade balances of both pulp and paper have been significantly amplified from the 1980s to the 1990s (figure 8.20.

The EU and North America appear in the core of the paper world system, through high consumption levels, net low valued pulp imports and net high valued paper exports. As pulpwood trade between world regions is minor, the EU-15 is then also an importer of land, water and nutrients for its paper production. Lower consumption regions (apart from Other Europe) are increasingly net exporters of pulp and net importers of paper. This growing gap between center and peripheries of the paper world system, eventually leads to an environmental load displacement

Unequal ecological exchange is also visible across world regions. This phenomenon becomes particularly strong in the 1990s, with the regions of Latin America, Asia and Other Europe suffering major falls in the terms of trade of pulp (figure 8.27(b).

Even though pulp has shown variations in the terms of trade across the world, these are quite low when compared to those of paper. For this reason, a country or region will hardly benefit from substantial comparative advantage when exporting pulp

but not paper. Moreover, in terms of environmental impacts, pulp production is much more pollution-intensive than paper production. Other European countries and Latin America appear in this particular situation.

Asia losses are probably related to its uncontrolled growth of population (but also consumption levels), together with its peripheral placement in the world systems. On the other hand, the increase in the terms of trade of paper for the net exporter EU-15, might be related to an increase in the demand of Asia.

This suggests that the EU builds its centrality in the paper market through the use of environmental space of both Latin America and the East European countries, while exporting most of its paper surplus to Asia at very beneficial terms of trade. The use of this environmental space happens partially through resource (roundwood) imports, but to a larger extent through imports of pollution-intensive pulp, at increasingly favorable terms of trade. Environmental load displacement is linked with ecologically unequal exchange.

Paper consumption is therefore hypercyclic with the environmental load displacement, anchored in beneficial terms of trade for the importing party. In particular, this has been achieved through a relocation of the activity with the highest environmental load (pulp production). This situation of unequal ecological exchange allows ”efficiency gains” in a similar trend to the Jevons' paradox, leading to decreasing prices of goods and pushing further their consumption.

9.2.2 Institutional change or destruction of the rural identity?

Other aspects that might have contributed to reducing conflicts are related to institutional change. A particular effect of market, institutional and policy changes was an higher integration of pulp in the production of paper. The market influenced through the decreasing pulp prices in countercycle with the paper prices. As pulp prices dropped in the international market (figure 8.11), the sector expanded its paper production and reduced the amount of pulp being exported from the country (figure 8.9(b)).

In fact, until 1990, the pulp and paper industry and its major exporting countries were in a relatively unfavorable position in the European market. After 1990, the pulp and paper producers are able to soften the inequalities in terms of trade 8.28. Two aspects might be concurring for this.

The first is related with the world demand for paper, which seems to grow at a faster pace than the supply. This is suggested by 1990s decline in the terms of trade of the major demand driver region - Asia. As a consequence of this resource scarcity pushed by a relatively peripherical region in the world system, paper producers achieve an higher stance in defining (and increasing) prices.

The second aspect is related with the entrance of the net exporters in the EU. Portugal entered the EU in 1986, while Austria, Finland and Sweden joined the EU in 1995. The participation in the common European market might have contributed to level the terms of trade of exporters and importers. At the EU level, the entrance in the economic community provided net exporters with better terms of trade.

Major institutional changes happened with the entrance in the EEC which not only led to market effects, but also to policy changes. These included forestry programmes, changes in Common Agricultural Policy and stricter environmental legislation. Other institutional changes include the legislative efforts that were undertaken in the late 1980s, by DGF. Two main effects could have brought down conflict. On one hand, there was a silencing of local voices by retrieving the capacity of local power to embargo land clearing operations that would result in eucalyptus afforestations. On the other hand, new technical regulations may have softened the type of afforestation interventions and put a halt on the land grabbing by the industry and professional foresters.

Institutional change might have, nevertheless, played a reduced role. A stronger effect in attenuating conflicts might originate from the intense rural abandonment and the consequent destruction of social networks of the inland areas of Portugal.

After 1989, the increase in the exosomatic metabolic rate, describing the use of energy, appears effectively related to a reduction of working hours at the societal level. Reduction of working time is then tightly related with the increase in leisure time, which

is pushing the household use of energy very strongly. This household intensification of the energy use is certainly supported by growing GDP. Wages increase, although not at the same rhythm as the GDP, particularly after 1989. Material flows increase and rely increasingly on imports to support the consumption growth. People also eat more, as can be seen by the increasing food metabolic rate (FMR).

These trends, visible in figure 8.32 show is that a new metabolic profile emerged in the Portuguese society. A domination of the urban over the rural. The appropriation of the rural space by the urbans, many of them former rurals running away from their declining regions into the new affluent society.

Part III

Conclusions

Overcoming issues in the analysis of environmental conflicts

The research presented in this thesis has resulted in multiple outcomes. First, it provided an analysis of the political ecology of the conflicts related to eucalyptus afforestations in Portugal in the 1980s. Second, through the analysis of this particular environmental conflict, together with an extensive bridging of literature on complex systems, ecological economics, anthropology, sociology, philosophy and political sciences, it created new understandings of the evolution of socioecological dynamics and their relation to conflicts.

The methodological approach used during this research combined a series of methodologies that employ social and natural science techniques to analyse complex systems. The analysis of human and ecological systems requires the ability to handle an open and expanding set of non-reducible perceptions and representations of the interactions of non-equivalent observers and agents. The use of methodological approaches that integrate different conceptualizations and measurements of welfare and sustainability is important given that these concepts are multidimensional in nature, therefore the evaluation of technological progress, policies, public plans or projects has to be based on procedures that explicitly require the integration of a broad set of various and conflicting points of view and the parallel use of non-equivalent representations.

This thesis attempted to deal with complexity and, in doing so, it succeeded in superseeding reductionism. This was achieved by relying on concepts such as methodological pluralism, narratives, storytellers, social metabolism and theoretical pathways.

Methodological pluralism was present in the development of the environmental history of the conflict, the institutional analysis and specially in the adaptation of the multiple scale integrated analysis of societal and ecosystem metabolism (MuSIASEM), with the extraction of narratives, values, identities and the use of different descriptive domains in heuristic models analysis. All this is part of a pre-analytical phase, which is of major importance in structuring the problem for analysis.

The environmental history of the conflict, together with existing literature on environmental conflicts and security, formed the majority of the open information space

that could support the problem structuring. Institutional analysis provided additional elements, particularly those concerned with whom has the power in the decision-making and who has the least power. The power issue is determinant in the definition of an adequate storyteller for the analysis of conflicts.

The concept of storyteller allows the exposure of power issues as seen through the lenses of the storyteller. For a proper understanding of conflicts the storyteller should be at least one of the main conflicting actors, allowing the understanding of their motivations, reasons for conflict and constraints that might be facing. In fact, conflict research which does not poses the question of what means the conflict, what is at stake there, what is being expressed there and who is expressing, risks to further expand insecurity by perpetuating injustices in the form of unequal access to resources or to decision-making processes. Furthermore, the definition of a storyteller is a fundamental step to guarantee the transparency of the process and to make clear whom should legitimate the problem structure developed by the analyst during the pre-analytical phase.

Social metabolism provides a valuable framework for understanding the relation between the biophysical aspects of economy and the development of human cultures. To deal with complexity, internal relationships within holons are put inside black boxes. Material, energy and capital flows related that enter or leave these holons, together with patterns of use of time and land. By hiding its internal complexities, the system is simplified, therefore exposing major patterns of socioecological reproduction - the metabolic profiles. Characterizing the metabolic profiles of concurrent holons and how they change across time is essential to understand the emergence of environmental conflicts. A particular important metaphor relates to the generation of hypercycles in certain holons, which become non-holonomic orders for other holons, therefore clashing or exerting pressures that put at risk their reproduction.

Finally, the use of heuristic models, particularly the impredicative loop analysis (ILA), allows the transformation of narratives into models. This was required, as dealing with complex systems requires developing quantitative analysis (Giampietro *et al.* , 2010b). The non-equivalent model representations related to the narratives have provided complementary conceptualizations and measurements of welfare and

sustainability, allowing the evaluation of technological progress, policies, public plans or projects. A critical assessment of the historical evolution (in an ex-post assessment) or the projected scenarios (for ex-ante assessments) of the information provided by the models, by contrasting the narratives of the storyteller and other actors, can provide profound understanding of the conflict dynamics and conflict potentials.

As MuSIASEM acknowledges the existence of different, non-reducible and incommensurable values, languages and backgrounds, this thesis was capable of dealing with environmental conflicts without omitting languages or values (therefore reducing the complexity of phenomena) for the sake of scientific objectivity. Favouring the exposition of the diversity of narratives in detriment of a positivist reductionism is capable of providing added transparency to participatory processes or historical analysis. The resulting subjectivity is properly addressed by relying on a dialectical discussion. Furthermore, a dialectical analysis of the social metabolism dynamics, from a political ecological perspective, has provided important insights on the relation of change, conflict and power relations.

The eucalyptus conflicts in Portugal

The conflicts against the eucalyptus plantations were particularly intense and visible in the late 1980s. The most immediate source of conflict seems to have been the set up of a paper pulp mill in Figueira da Foz (center-west of Portugal) in 1984. The equipments had been projected for the Angola overseas colony, but with the 1974 Revolution of the Carnations and the end of the overseas empire, the project had to be dropped. The new pulp mill, producing eucalyptus sulphate pulp, has strongly pushed the demand for raw materials, pushing the pulpwood prices up and leading to a situation of resource scarcity that peaked in 1989.

Eucalyptus plantations continued to expand in the country in the 1990s, supplying a growing national pulp and paper industry and the global demand for paper. However, conflicts against eucalyptus plantations became silent after 1989. The analysis of the conflicts phenomena focused on understanding which social, cultural, economical or

ecological aspects or dynamics could be in place in the particular period of the late 1980s, allowing conflicts to emerge. The dynamics of conflict appeared as a mix of biophysical constraints, economic development, social movements dynamics and cultural aspects related to identity.

In terms of biophysical constraints, the resource scarcity felt by the pulp industry was projected into strategies of land grabbing, in an attempt to capture as much land as possible for eucalyptus afforestations. Land grabbing seems to have taken place particularly in marginal lands, not originally classified as agriculture land, but still used under consuetudinary rights for grazing (such as the *montes livres*) or for providing ecosystem services, with particular emphasis for water supply.

The entrance of Portugal in the EEC in 1986, has increased the pace of economic growth. A strong modernization process gained momentum in the country, characterized by an industrial expansion and by productivity increases in agriculture. The process was followed by major increases of material use and exosomatic energy, allowing the replacement of human labour in many sectors, while increasing the amount of leisure time. Rural abandonment and migration to urban areas followed the productivity increases in agriculture and the loss of employment opportunities in the rural areas.

This deep and intense social and territorial reorganization, generated a very conflictive period, particularly in agriculture related issues, due to their relation with the rural identities. Rural identities became vulnerable with the expansion of industrial agriculture and industrial forestry. The least modernized farmers and peasants, as well as those that relied on agricultural work conducted outside their own private property (such as pastorals), were particularly vulnerable. They enrolled in a fight for survival of their activities, opposing the expansion of one of the most visible industrial threats. Among these threats was one that affected their identitary relation with the land: the eucalyptus.

The peak number of fires in 1989 exposes a relation between this type of events and the social conflicts taking place. Already before this date, particularly since 1984, the area burned by fires was particularly high, suggesting that the system had suffered some change. Such change, which maps to the starting of operations of the Figueira

da Foz pulp mill, has brought the system to a fast phase. The disruption created by the fast phase has, in turn, provided an immediate supply of pulpwood at lower prices than would otherwise be expected, in face of resource scarcity.

The high resource value of pulp supported the expansion of the pulp industry in Portugal. In particular, the high prices of pulp in the late 1980s, have provided a strong capitalization of the industry, creating a proper climate for its continued expansion (eventually resulting in an increased integration of pulp in national production of paper). This has pushed pulpwood prices achieve a maximum in 1989-90. The economical optimism towards the sector, that was visible within the governmental spheres (where the eucalyptus was described as "the green oil" of Portugal), materialized in a race for new lands for eucalyptus, leading to phenomena of illegitimate land grabbing. The new pressure for converting the lands to eucalyptus have contributed to an extremely conflictive scenario.

Finally, the importance of the rising ecological movement in bringing conflicts to public, cannot be underestimated. The ecologist movement was providing the vulnerable rural identities with scientific sound arguments that allowed their discourse to be projected into the mainstream media. They also had a stronger stance in lobbying at the national level, allowing the peasants and other rural people to feel empowered. Nevertheless, the values and languages of the rural identities conflicting against the industrial afforestations can be described as "environmentalism of the poors". In fact, rural peripheries, such as those in Portugal where the conflicts took place, can be understood as part of the broad definition of political South. By exposing, through conflict, a different language of valuation towards projects that were perceived as damaging to their metabolic profiles, conflicting peasants might have contributed to slow down the industrial expansion.

Ecological distribution conflicts in the world-system

The consumption of paper continued to grow worldwide, both as a result of the increasing per capita consumption of EU and North America and of the population bomb

of Asia. This increasing consumption appears related with the growth in the pulp and paper production in Portugal, which in turn pushes the expansion of eucalyptus plantations in Portugal. However, this expansion did not result in further conflicts. Why then, did conflicts stop in Portugal after the 1980s?

The reasons for the silencing of the conflicts against eucalyptus in Portugal in the 1990s appear anchored both in institutional change and on an increasing importance of pulp production in more peripheral regions of the world system. Institutional change mitigated the conflicts both through stricter regulation on afforestations and through disempowerment of local actors. The new legislative package, influenced by new environmental criteria brought by the entrance in the EEC, has forced large scale afforestations to be subjected to environmental impact assessments. However, one of the new laws has also taken away the local authorities power to embargo land clearing operations leading to afforestations. This was one of the most used legal instruments to stop afforestations and allow the conflict to be publicly exposed, often leading to the drop of the projects by the pulp companies. Despite the existence of a participatory process at the national level, coupled with the environmental impact assessment, participation was scarce.

A parallel dynamic was a restructuring of the pulp and paper industry world system. Portugal was, and continued to be (at least until 2000), in a position of periphery in the world system of the paper sector, as a major exporter of pulp which directly relates to pulpwood and the needed land. However, in the 1990s it approached a core position by increasing the physical trade balance of paper at increasingly beneficial terms of trade. Part of the reason why this was possible was that there was a shift in the world system, pushing pulp production to more peripheral regions, such as Latin America and Eastern Europe. Terms of trade for pulp have sunk in these regions after 1990, exposing a phenomena of unequal ecological exchange.

Unequal ecological exchange appears as a strong mechanism behind the continuous expansion of paper consumption. By allowing the displacement to the peripheries of the activities with the most impacts at increasingly beneficial terms of trade, it resembles the Jevons' paradox (Jevons, 1866), where the reduction of costs to the final consumer

further push their consumption. As a consequence, resource and land use can continue increase. In this context, conflicts perpetrated by social movements, which express an "environmentalism of the poor", appear as an important opposition dynamic to the imbalances generated by the peripheralization. Polanyi (2001, p.35) had already noted "that a process of undirected change, the pace of which is deemed too fast, should be slowed down, if possible, so as to safeguard the welfare of the community".

Projects in Latin America for eucalyptus expansion (often associated with the installation of new pulp mills), have been receiving strong local grassroots resistance and increasing international attention. In Portugal, resistance did not result in a relocation of conflicts, in part due to institutional strategies related to the existence of a public industry. This is not the case with the Latin America pulp industry, where most capital is private and originating in the North. As such, it is possible that Latin America and possibly Eastern Europe, will start to reduce the rate of expansion of pulpwood extraction and pulp production, therefore moving away from their periphery position, due to the construction of resistance and institutional change (as suggested by Gerber *et al.* 2009 empirical study on Ecuador). This implies the displacement of pulp production and the associated pulpwood extraction to another region.

In fact, this seems to be happening recently, with several projects of afforestation for Africa appearing in parallel with alarming reports of major land grabbing (which, until now, has been mostly related to the global food crisis and the demand for energy crops, as reports Williams, 2009). In Uruguay, for example, the Spanish company ENCE has delayed a project for a pulp mill, alleging lack of investment possibilities due to the crisis. On the other hand, the Portuguese Portucel Soporcel, which had originally considered to join with ENCE in the Uruguay project, has now announced the installation of a big pulp mill in Mozambique, together with large-scale eucalyptus afforestation plans in 173 thousand ha of lands given by the Government (Pedro, 2009; Ind, 2009; Silva, 2009). Arguments for putting Mozambique as priority for investment, included the easier definition of land ownership, and the potential to export to the Asian market (Cel, 2010).

On the other hand, Carrere & Lohmann, 1996, pp.87-88 have pointed out that the

pulp industry can also carry strategies that try to mitigate the effects of local resistance. Among these are divide-and-conquer strategies (waging economic or cultural war on pockets of resisters, buying off potential sceptics), oppression, relocation of activities and participatory mechanisms to legitimize their actions. In fact, most, or even all, of these strategies seem to be operating in the present. The relocation of activities, in particular, has been exposed by the analysis conducted in this thesis. As resistance grew in Europe, production was transferred to Latin America and Asia; as resistance is growing and achieving global reach in Latin America, new major afforestations seem to be on the move to Africa, where the social movements are less structured and powerful. However, paper consumption continues to grow in parallel with industrial monoculture afforestations, independently of the increased expression and globalization of the conflicts. Even if a part of this can be attributable to the effects of relocation to still unexplored territories, other phenomena might be operating. In particular, the potential of resistance in the peripheries, to stop deleterious projects through high consumer awareness in consumption centres, might be hampered by the mechanisms which preserve the capitalist hegemony, such as commodity fetishism.

While the typology of paper commodities was not analysed in this thesis, packaging has been suggested to be the main source of increasing production, accounting for over 50% of the total uses of paper (WRM, 2008). The relevance of this specific typology of paper separates the expansion of industrial forestry from consumer accountability, through two mutually reinforcing mechanisms: (a) paper packages as a non-consumer commodity and (b) packaging as a carrier of a meaning, able to transform the relation between the producer and the consumer.

An important end-use of paper packages is in the packaging of commodities for transport. This end use of paper, in the form of an industrial, non-consumer commodity, is related to the effect of expanding market capitalism to include new commodities and territories, as well as the parallel increase of trade distances. As the choice of packaging by trade or sales companies is only marginally related to the end consumer, marketing and logistical functions supersede the environmental criteria when there are trade-offs (see Prendergast & Pitt, 1996). Even though ecologically concerned consumers might look into the type of packaging as a determinant of their purchases (Schwepker Jr &

Cornwell, 1991), the overall effect is relatively small, because (a) this niche is relatively marginal and (b) the choice of packages is limited by constraints imposed by the hegemony, which limit production changes to only marginal improvements (see Princen *et al.* , 2002). Furthermore, packaging has an important role in creating commodity fetishism, which further stimulates desire and consumption.

Branding and marketing studies strongly acknowledge the importance of packaging in influencing consumer behavior (Wansink, 1996). The "never-touched-by-hand packaging" (Mulvey, 1993), which create "fetishes-on-display" that hold "the crowd enthralled even when personal possession was far beyond their reach" (Buck-Morss, 1989, p.82), is required to hide any forms of exploitation that are incorporated on the commodity itself. This can be related to Slavoj Žižek's antagonism between fetishism as part of social relations and commodity fetishism (Žižek 1990).

The increasingly sophisticated packaging of commodities operate to establish social relations between things, while hiding the social relations between people. Following the concept of Lacan's mirror stage (and Žižek's political interpretations of it), the consumer loses its relation with the production process itself and, consequently, to the producer. The package becomes the mirror of the consumers Ego, operating within the dichotomy between the surface of a product and what is embodied in its depth. In this perspective, packaging appears as a core element of creating commodity fetishism, in a system of production supported by social and ecological injustices. Furthermore, it is intimately related with the processes of globalization (as suggested by Bernstein & Campling, 2006), where consumption growth in the centre of the world-system pushes the externalities of production - and related struggles for social and environmental justice - to the peripheries.

The process of relocating the extraction of resources and production of commodities with high environmental load to the less consuming-peripheries, further helps to avoid any stains in the mirror, which could threaten the identification of the consumers Ego with the commodity. This hiding of the injustices and unsustainable aspects of the commodity production, appear intimately related to the sophistication of the surface envelope, particularly through the construction of social and ecological meanings on the

consumption side, which do not necessarily map into the dynamics that take place on the production side (see, for example, Carimentrand & Ballet 2010 on impacts related to fair trade labelling of quinoa, Kosoy & Corbera 2010 for a parallel on payments for environmental services, or Lang 2008 for a critique on voluntary certification schemes of the pulp and paper industry).

The importance of packaging as an end-use of paper appears, therefore, related to meanings and dynamics that go much beyond its production, consumption and related land use conflicts. It seems to simultaneously push unequal ecological exchange and being reinforced by it. Further empirical research is required to address the articulation of: (a) overall paper consumption and its end use typologies; (b) the increase in the amount of paper (or other materials) packaging and the sophistication of the commodities' envelopes; (c) the sophistication of these envelopes and their role as a Lacanian mirror, which hides embodied injustices; and (d) the increase of international trade flows and the growing end use of paper for packaging.

These lines of research have the potential to coherently bridge different types of "environmentalism of the poor" related conflicts within the dynamics of capitalist expansion. The capacity to establish this articulation, may prove to be necessary to escape the constant appropriation of discourses by the capitalist hegemony (see, for example, Klein, 1999; Holt, 2002). Therefore, continuing research in this direction, is of major importance in understanding whether conflicts, particularly those related to an "environmentalism of the poor" discourse, are able to target the hegemonic dynamics leading to conflicts in the peripheries, or if they merely result in a relocation - and even intensification - of ecologically unequal exchange to other parts of the globe.

A framework and meta-grammar for conflict research

The MuSIASEM framework has provided an adequate background for transforming into models different narratives and spatial levels. The adaptation of this framework and its integration with literature in environmental security and conflicts were able to bring valuable scientific and political contributions to the environmental history and

prediction of conflicts, under diverse political, cultural and sociological conditions.

The empirical analysis of the political ecology of conflicts against eucalyptus plantations in Portugal, has provided a good understanding of the cross-scale and cross-boundary connections and dynamics that led to the conflict situation. The interconnections of national, as well as foreign policies and international trade, with conflict dynamics in the rural Portugal, have been exposed by the models. This *ex-post* analysis of the eucalyptus conflicts in Portugal, combining static and evolutionary perspective, were able to bring valuable insights in pattern recognition. Static analysis provide an assessment of different metabolic profiles and the understanding of points of tension or disruption of powerless or slower holons by more powerful or faster holons. Evolutionary analysis allow the recognition of emerging hypercycles that are capable of creating instabilities within the holons that might threaten their reproduction. Furthermore, through the navigation across multiple scales, phenomena such as the growing consumption of paper (and its global geographic differences), could be related to ecological unequal exchange and local environmental conflicts.

Further historical case studies can help to improve and consolidate a metagrammar for translating the analysis of social metabolism at multiple scales, into meanings that relate to the emergence of environmental conflicts. With the perspective of facilitating the replication to other case studies and the creation of a common metagrammar, most of the data used to feed this thesis models was chosen to be simple, scalable and easily found for other countries or regions.

The framework developed in this work may also be applied to decision-making processes or other types of *ex-ante* assessment of scenarios. Such processes of integrated analysis benefit from including participation in the problem definition and policy analysis (as suggested by Guimarães Pereira *et al.* , 2006; Videira *et al.* , 2010). Therefore, possible uses of this framework include sustainability assessments or the development of empowerment initiatives, where the actors' option spaces can be constructed with a biophysical perspective.

The post-politics related to deliberative decision-making processes, as well as technocentric analysis, has been explicitly addressed in the framework developments of this

thesis. Power issues are exposed, while different languages of valuation, including those which are marginal to the hegemony, are incorporated through the use of narratives in the analysis. The capacity to simultaneously analyse different languages of valuation is achieved by relying on modelling functions that allow the parallel visualization of different descriptive domains. Two R statistical package functions have been developed: (a) a 4-angled models for impredicative loop analysis (ILA.R), and (b) a bi-dimensional evolutionary arrows plot (ArrowsPlot.R).

The ILA function has provided a compact, parallel representation of non-equivalent descriptive domains across multiple scales (spatial and sectorial). The ability to synthesize multiple causal factors of ecological distribution conflicts under the direct scrutiny of the analyst eye, makes impredicative loop analysis a powerful tool for dealing with social and ecological complexity. This quantitative-based analysis of environmental conflicts, stimulates the creation of important bridges between ecological economics, political ecology and environmental history.

The bi-dimensional evolutionary arrows plot, provided interesting visualizations of evolutionary mechanisms leading to ecologically unequal exchange. A particularly useful representation in identifying this phenomenon, was one which contrasted the evolution of terms of trade with the physical trade balance per unit of land.

While these functions were designed with the purpose of analysing environmental conflicts, they can be useful for other applications of the MuSIASEM framework. However, these functions, particularly the ILA, are still limited in features and should be considered beta software. Future developments might provide visual dynamic interactions of the analyst or users with the models. Furthermore, it might be useful to integrate these technical developments with current efforts being made by other MuSIASEM researchers (for example, Giampietro *et al.* , 2010b,a), to make more user-friendly representations. The articulation of different complementary representations can be useful not only for improved visualization in static analysis, but also to support participatory or decision-making processes, where proposed scenarios of development where congruence is enforced and trade-offs exposed.

Additionally, these developments are able to promote interdisciplinary dialogue.

Communication among researchers and analysts coming from different backgrounds can benefit from the formalization of models which are simple, flexible yet consistent across different domains and scales. Furthermore, the use of theoretical pathways, provide an excellent mechanism of communication between narratives and descriptive domains, on which each researcher, according to its background, can focus. However, the exploration of different paths of entailment does not, on its own, provide a broad enough set of relevant elements for an integrated analysis. The dialectical approach to discuss the results is a key element for a critical and truly transdisciplinary integrated analysis of environmental conflicts, or other sustainability issues.

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Appendices

Appendix I: Soft Systems Methodology

Step 1: Feeling the disequilibrium, recognizing that there is a problem even if it is not clearly expressed

Reaching an agreement on the existence of a problem is not easy. Moreover, it is common to face a denial of the existence of problems. This appears frequently when there is a treat of discussing the identity of those who detain power.

Step 2: Generate actively as many points of view for the system as possible

In this step the idea is to paint the rich picture, which means taking into account as many explicitly conflicting perspectives as possible, rather than trying to build a model which fits a specific narrative.

Step 3: Explicit development of abstractions, finding the root definitions

This step of contraction aims at finding a workable representation of the problem situation. This requires beforehand a sementaic problem structuring, where the analyst must be able to answer a set of questions such as: what is the system of interest? What is it doing? Why is it relevant? For whom is it relevant? Which criteria can be of interest to describe and take decisions on that? Which system attributes are conflict prone?

In this step, one should expect to find different identities for the system, which are linked to the narratives of the different actors which reflect their perceptions of the physical world. As was mentioned in the previous chapter, such identities are also changing across the hierarchical levels. Having these several different sets of root definitions (or identities) is “not only possible,

but desirable." (Allen and Hoekstra, 1992, p. 313 *cit* Giampietro (2004)).

Checkland proposed an heuristic tool with the acronym CATWOE, to help defining a useful set of root definitions for the problem structuring (quoted from Allen and Hoekstra, 1992 *cit* Giampietro (2004); emphasis and in-bracket contents are of my responsability):

C - The client of the system and analysis.

A - The actors in the system.

T - The transformations of underlying processes. What does the system do? What are the critical changes? These critical transformations are generally performed by the actors.

W - *Weltanschauung* (worldview); identifies the implicit worldview invoked when the system is viewed in a particular manner. This defines the set of phenomena of interest.

O - The owner of the system. Who can pull the plug on the whole thing?

E - The environment, that is, what the system takes as given. By default, the environment defines the scale of the system's extent by being everything that matters that is too large to be differentiated.

C, A and O are refering to different categories of relevant social actors (or stakeholders) and deal with relevant issues associated to the normative component of the process. To better understand the distinction between these different categories - which can be overlapping - I summarize the descriptions made by Giampietro (2004, p.116):

Clients - The stakeholders who are ethically relevant in relation to the *Weltanschauung* in which the process of decision making is taking place. They might be nonagents or have no power in the negotiation, but one might decide to include them in the process for ethical reasons (for example, future generations).

Actors - The stakeholders who are relevant agents within the mechanisms determining the set of phenomena of interest. The models and scenarios that we build should take into account the possible reactions of these agents to the changes brought by certain options or policies. Agents might not have a strong negotiation power in the process. In fact, they might not even be humans when dealing with ecological systems.

Owner - The stakeholders which exhibit a clear power assimetry in the process of negotia-

tion used to define which perceptions count in the definition of the problem structuring. To deal with such major power assimetries, it is essencial to understand the power structure among the considered set of clients and actors.

The letters T and E are related to our representation of facts and have to do with the descriptive component of the process. Summarizing Giampietro (2004, p.117):

Transformations - Consists of "the set of modeled behaviors resulting from the choice of encoding variables and inferential systems used to describe the reality within the selected representation of relevant perceptions". Each transformation within each individual model describes a particular dynamic that can be simulated using simple time.

Environment - Consists of "the set of assumptions about the compatibility of initiating conditions (stability of structural elements) and admissibility of boundary conditions (stability of the meaning of a given function in a given context)." Defining the environment requires the modeler to make choices in respect to the potential obsolecence of the models used to represent transformations and, therefore, the time scale under which the model can be considered valid.

The letter W makes the link between the descriptive and normative components. From Giampietro (2004, p.117):

Weltanschauung - consists of "the preanalytical set of choices about (1) what should be considered the universe of relevant facts (the universe of discourse within which analysts look for explanations and models) and (2) how to structure the representation in this universe (after deciding what has to be given priority over the rest in relation to agreed-upon goals). The historical path plays a major role here. To define who belongs to the different categories of C, A, O and what is to be described in T and E, the modeler must look at the past history of the human group and the "virtual future", expressed by the wills and wants of the whole group. Adequately defining this category is essential to keep the "coherence in the process leading to a shared perception of the reality in relation to action and the relative representation".

Along the process, it is important to assure a quality control between the descriptive and normative components.

Step 4: Building the models

Each set of nonequivalent identities - or alternative root definitions - requires the construction of a different model.

Step 5: Returning to observations of the world and checking the model against what happens

In this step the actors might comment on the model and suggest changes that increase their consistency according to their specific knowledge. Then, a selection has to be made from all the possible models, indicators, metaphors and principles that could be applied, with the objective of created a useful formal problem structuring for use in the decision making process.

Step 6: Exploration of feasible and desirable changes

Using the analytical tools that have been developed, the modeler/analyst and/or the relevant stakeholders must explore the feasible and desirable changes. If nothing which is both feasible and desirable is found in the negotiation process, then probably something went wrong in the original structuration of the problem. When this occurs, one should make an additional iteration in the process and review the validity of the perceptions and expectations.

Step 7: Identification of desirable and feasible changes of the system

At the end of the step, one should be able to have decisions regarding the selections and implementation of a policy.

Step 8: Evaluation, widening the view of the whole process

Achieving a more effective evaluation requires relying on nonequivalent observers to monitor unexpected side effects. The bigger the diversity, the better the ability to deal with uncertainty and unavoidable ignorance.

Appendix II: Variables used in calculations of pulp and paper related material flows

Parameter	Description	Units	Source
Pulpwood+Particles	Pulpwood, chips, particles and wood residues. In production, the commodities included are pulpwood coniferous and non-coniferous. In trade, the aggregate includes, in addition, chips or particles and wood residues. It is discriminated in coniferous and non-coniferous wood.	Solid volume of roundwood without bark: cubic meters	(FAO, 2005)
Pulpwood (Round & Split)	Wood in the rough other than logs - for pulp, particle board or fibreboard. Pulpwood may be barked or unbarked and may be in the form of roundwood or splitwood. In production, it may include the equivalent of wood chips made directly from roundwood.	Solid volume of roundwood without bark: cubic meters	(FAO, 2005)
Industrial Roundwood	Sawlogs or veneer logs, pulpwood, other industrial roundwood and, in the case of trade, also chips and particles and wood residues. It is discriminated in coniferous and non-coniferous wood	Solid volume of roundwood without bark: cubic meters	(FAO, 2005)
Wood Pulp	Mechanical, semi-chemical, chemical and dissolving wood pulp.	Weight: metric tons (air-dry = 10% moisture)	(FAO, 2005)
Paper+Paperboard	Newsprint, printing and writing paper, other paper and paper- board.	Weight: metric tons	(FAO, 2005)

Appendix III: Data sources

NOTE: ALL DATA USED IN THIS RESEARCH IS AVAILABLE AT http://phd.gualter.net

Land use

Variable	Description	Unit	Period	Source
TAL	Total available land (land area)	1000 ha	1980-2003	FAOSTAT, 2009
LIP	Land in production	1000 ha	1980-2003	own calculation
LIA	Land in agriculture	1000 ha	1980-2003	FAOSTAT, 2009
LIF	Land in forestry	1000 ha	1980-2003	FAOSTAT, 2009
Arable	Arable land	1000 ha	1980-2003	FAOSTAT, 2009
Crop	Permanent crops	1000 ha	1980-2003	FAOSTAT, 2009
Pasture	Pasture land	1000 ha	1980-2003	FAOSTAT, 2009
Eucalyptus	Eucalyptus plantations area	1000 ha	1980-2003	DGRF, 2006; Mendes, 2002; own estimations

Time use

Variable	Description	Unit	Period	Source
THA	Total Human Activity	10^6 hours	1980-2003	INE (2009); INE (1999); own calculations
HA_{PO}	Human activity dedicated to personal care and sleeping	10^6 hours	1980-2003	
DHA	Disposable Human Activity	10^6 hours	1980-2003	
HA_{HC+LE}	Human activity dedicated to household chores, leisure and education	10^6 hours	1980-2003	
HA_{PW}	Human activity dedicated to paid work	10^6 hours	1980-2003	
HA_{agri}	Human activity dedicated to work in agriculture	10^6 hours	1980-2003	
HA_{PP}	Human activity dedicated to work in the pulp and paper industries	10^6 hours	1980-2003	
$HA_{primary}$	Human activity dedicated to work in the primary sector	10^6 hours	1980-2003	

Variable	Description	Unit	Period	Source
Total population	Total country population	hab	1980-2003	OECD (2009)
Population by age and sex	Country population, by age group (<15, 15-24, 25-64, >= 65) and sex	hab	1981; 1985-87; 1989-2003	INE (2009)
Employment rate	Share of persons of working age (15 to 64 years) in employment	%	1980-2003	OECD (2009)
Unemployment rate	Share of unemployed persons as a percentage of civilian labour force	%	1980-2003	OECD (2009)
Average hours worked	Hours per year per person in employment	hour/year	1986-2003	OECD (2009)
Students	Number of students in high school and university (male and female)	hab	1980-2003	GEPE (2006); GPEARI (2008); GIASE (2009)
Employment in primary sector		hab	1980-2003	FAOSTAT (2005); FAOSTAT (2009)

Variable	Description	Unit	Period	Source
Employment in agriculture		UTA	1979; 1989; 1993; 1995; 1997; 1999; 2003	INE (1982); INE (2007)
Employment in forestry		UTA	1990;2000	FAO (2006)
Employment in pulp and paper sector		hab	1982; 1985; 1987-2000	CELPA

Energy flows

Variable	Description	Unit	Period	Source
TET	Total Exosomatic Throughput	PJ	1980-2002	IEA Extended Energy Balances
ET_{HH}	Exosomatic throughput for the households (residential)	PJ	1980-2002	IEA Extended Energy Balances
ET_{PS}	Exosomatic throughput of the productive sector (industry)	PJ	1980-2002	IEA Extended Energy Balances
ET_{SG}	Exosomatic throughput of the services and governmental sector (commercial and public services)	PJ	1980-2002	IEA Extended Energy Balances
ET_{Ag}	Exosomatic throughput of agriculture, hunting and forestry	PJ	1980-2002	IEA Extended Energy Balances
ET_{PP}	Exosomatic throughput of paper, pulp and printing industries	PJ	1980-2002	IEA Extended Energy Balances
ET_{food}	Food consumption	GJ	1980-2003	INE (2007)
FMR	Food Metabolic Rate	J/h	1980-2003	$Food_{cons}/THA$

Material flows

Variable	Description	Unit	Period	Source
DE_{total}	Domestic extraction	kton	1980-2000	Eurostat, 2002
DMI_{total}	Domestic material input	kton	1980-2000	Eurostat, 2002
DMC_{total}	Domestic material consumption	kton	1980-2000	Eurostat, 2002
DE_{bio}	Domestic extraction of biomass	kton	1980-2003	Eurostat, 2002; SERI, 2008; FAOSTAT, 2005 (own calc)
DMI_{bio}	Domestic material input of biomass	kton	1980-2003	Eurostat, 2002; FAOSTAT, 2005 and FAOSTAT, 2008 (own calc)
DMC_{bio}	Domestic material consumption of biomass	kton	1980-2003	Eurostat, 2002; FAOSTAT, 2005 and FAOSTAT, 2008 (own calc)
DE_{For}	Domestic extraction of timber	kton	1980-2003	FAOSTAT, 2005 (own calc)
DE_{Ag}	Domestic extraction of agriculture (plant + grazing)	kton	1980-2003	FAOSTAT, 2005 (own calc)
DE_{PP}	Domestic extraction of wood for pulp	kton	1980-2003	FAOSTAT, 2005 (own calc)
DMC_{PP}	Consumption of wood by pulp industry	kton	1980-2003	$Conseuca + Cons_{pine}$
DMC_{EP}	Consumption of wood from eucalyptus by pulp industry	kton	1980-2000	CELPA

Variable	Description	Unit	Period	Source
DMC_{pine}	Consumption of wood from pine by pulp industry	kton	1980-2000	CELPA
$Prod_{food}$	Production of food	kton	*1980-2003*	INE, Estatísticas Agrícolas 2006; FAOSTAT, 2005 (own calc)
$Cons_{food}$	Consumption of food	kton	1980-2003	INE (2007)
$Prod_{pulp}$	Production of wood pulp	kton	1980-2003	FAOSTAT, 2005
$Prod_{paper}$	Production of paper	kton	1980-2003	FAOSTAT, 2005
Exp_{pulp}	Exports of wood pulp	kton	1980-2003	FAOSTAT, 2005
Exp_{paper}	Exports of paper	kton	1980-2003	FAOSTAT, 2005
Imp_{pulp}	Imports of wood pulp	kton	1980-2003	CELPA, 1996; FAOSTAT, 2005
Imp_{paper}	Imports of paper	kton	1980-2003	CELPA, 1996; FAOSTAT, 2005
$Cons_{paper}$	Consumption of paper	kton	1980-2003	FAOSTAT, 2007; CELPA
$Cons_{pulp}$	Consumption of pulp	kton	1980-2003	CELPA

Capital flows

Variable	Description	Unit	Period	Source
GDP	Gross Domestic Product	million euro	1980-2003	OECD, 2009
AV_{PS}	Added value from industry and construction	million euro	1980-2003	INE (2007)
AV_{SG}	Added value from services and goods	million euro	1980-2003	
AV_{Ag}	Added value from agriculture	million euro	1980-2003	
AV_{for}	Added value from forestry	million euro	1980-2001	INE (1991a); INE (2008)
AV_{PP}	Added value from pulp and paper industry	million euro	1980-2003	CELPA annual reports
$Wage_{Ag}$	Wages in agriculture, as a proportion of the added value	million euro	1980-2003	INE (2007)
$Price_{euca}$	Annual minimum prices of eucalyptus wood at the entrance of the factory	euro/ton	1980-2000	CELPA (1985); Feio (1998)

Variable	Description	Unit	Period	Source
$Price_{pulp}$	Average annual prices of pulp	euro/ton	1980-2002	Own calculations ($Value_{pulp}/Prod_{pulp}$)
EV_{PP}	Export value of pulp and paper	million euro	1980-2003	FAOSTAT (2005), own calc
EV_{pulp}	Export value of wood pulp	million euro	1980-2003	FAOSTAT (2005)
EV_{paper}	Export value of paper	million euro	1980-2003	FAOSTAT (2005)